THE MONTHLY

Review

MARCH • • • 1946

To The Plating Industry

FREDERICK GUMM *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N.J.

KEARNY 2-4142 · RECTOR 2-0677

To The Plating Industry:

IMPORTANT FACTS ABOUT PLATING DIE CASTINGS

Copper-Nickel-Chrome plated Zinc-base die castings often look perfect after plating, when using old cleaning methods. However, when subjected to modern baking tests, the deposit will blister and peel.

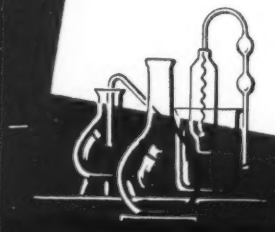
This is eliminated by using Clepo MOL-EX Process which removes buffing compounds and cleans Zinc-base die castings so that they can be Copper-Nickel-Chrome plated and will pass the baking test without any blistering or peeling.

The CLEPO MOL-EX Process is very flexible and adapts itself readily to your own cleaning and plating cycle whether hand-operated tanks or full automatic equipment is used.

Contact our local Service Man for detailed recommendations.

Yours very truly,

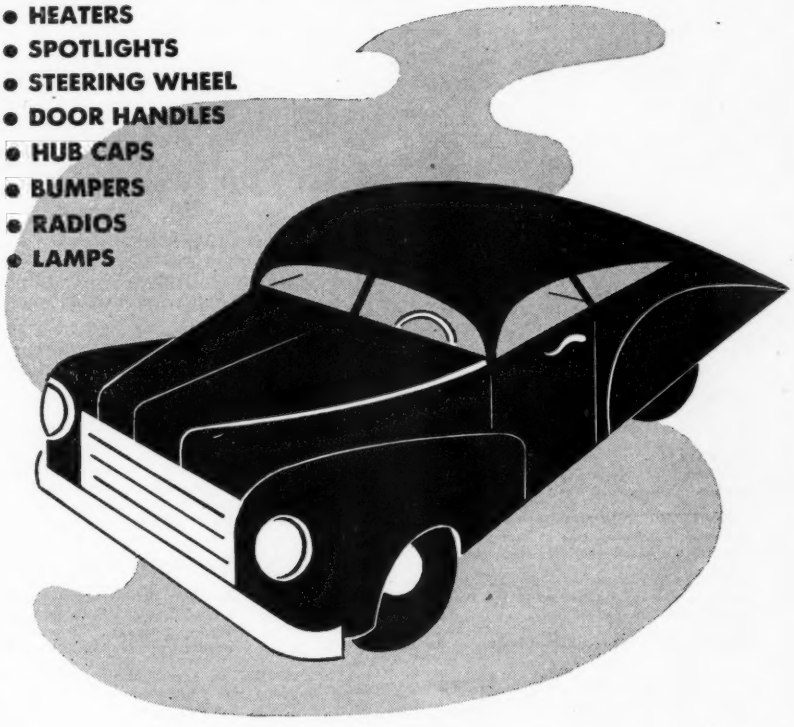
CLEPO LABORATORIES
FREDERICK GUMM CHEMICAL COMPANY



FREDERICK **GUMM** *Chemical Company*

538 FOREST STREET, KEARNY, N.J.

- TRIM
- GRILLE
- HEATERS
- SPOTLIGHTS
- STEERING WHEEL
- DOOR HANDLES
- HUB CAPS
- BUMPERS
- RADIOS
- LAMPS



OAKITE COMPOSITION NUMBER 90

. . . offers many outstanding advantages to the production man concerned with high quality chromium plating of automobile accessories, hardware and trim. Specifically designed for ANODIC degreasing, Oakite Composition No. 90 combines high wetting-out and emulsifying properties with effective penetrating action. Ask your nearby Oakite Technical Service Representative to demonstrate Oakite Composition No. 90's ability to clean faster over longer periods without excessive foaming. Or write us for FREE data.

OAKITE PRODUCTS, INC., 40 THAMES STREET, N.Y.

OAKITE *Specialized* **CLEANING**
MATERIALS · METHODS · SERVICE

Finishing and PROCESSES PRODUCTS *of* ENTHONE RESEARCH

TEAR OUT
Check and Mail for Latest Information on
BETTER METAL FINISHING

FINISHING PROCESSES

ALUMON — a process for treating aluminum and its alloys to prepare it for electroplating with other metals.

ALUMOX — a process for chemically oxidizing aluminum to impart protection to corrosive atmospheres and prepare it for organic finishes.

EBONOL "C" — a process for chemically oxidizing and blackening copper and copper alloys. The finish is also a good base for painting.

EBONOL "S" — a chemical process for blackening iron and steel operated in the temperature range from 285-290°F.

EBONOL "Z" — a process for blackening zinc and zinc alloys.

FINISHING PRODUCTS

Aids for Better Pickling

ACID ADDITION AGENT — a surface active material which is added to hydrochloric and sulphuric acid pickles to prevent fuming, to inhibit attack upon the steel and promote better pickling.

INHIBITOR 7C — a powerful inhibitor for hydrocloric acid pickles either hot or cold to prevent attack upon base steel. The inhibiting action is approximately 99%.

COMPOUND NR-37— an organic material which is added to hot water used for drying after pickling to prevent rusting or yellow staining of steel. No film is left upon the work to interfere with organic finishing.

Better Cleaning

ALUMINUM CLEANER E — an etching type cleaner for cleaning aluminum as well as etching.

ALUMINUM CLEANER NE — a powerful cleaner for cleaning aluminum without any attack or tarnish.

BRASS CLEANER — a powerful cleaner but has a mild action on brass, nickel-silver, lead-tin alloys, steel and other metals.

CLEANER 100 — an alkali cleaner of very high detergency for cleaning steel by soaking or electrolytic means.

EMULSION CLEANER — an emulsifiable solvent type cleaner for removing all solid dirt and oil as well as buffing compositions from all metals without attack or tarnish.

STRIPPERS

ENAMEL STRIPPERS: Various solvent and emulsion type strippers are available for rapidly removing enamels, lacquers and other organic coatings from all metals without attack.

ZINC STRIPPER — an alkaline process for rapidly stripping zinc plate from steel without any attack upon the steel.

RUST-PROOFING MATERIALS

NO. 15 OIL — a thin film oil for rust-proofing of steel. Protects 24 hours in salt spray and is a water shedding polar type oil.

SOLUBLE OIL — an emulsifiable rust-proofing oil used diluted with water to apply a rust-proofing film. Can be used with hot or cold water. Also an excellent cutting oil.

1568 WAX — an emulsion of clear hard-drying waxes to produce a hard rust-proofing finish on metals. Air dries fast and does not rub off.

THE ENTHONE COMPANY
ENTHONE
Dept. MR
[illegible] Elm Street, New Haven 2, Connecticut

GE chooses Luster-on

Engineers at General Electric looked over the field and chose Luster-on* for the protective bright dip for zinc plated parts on their new 1946 radios. Read their statement — it tells the whole story of Luster-on superiority. Then send the coupon and a sample part for proof that you can see with your own eyes.

Here's What G-E Says . . .

We are using Luster-on on the chassis, speaker shells and other parts of our current radio line. Over and above the pleasing brilliancy of the finish, we find that with Luster-on we experience no difficulty in spot welding directly on finished surfaces, thus speeding production; and Luster-on affords protection from corrosion and salts formation to the parts treated, thereby promoting a greater expectancy of continued good service from our radios.

Paul L. Chamberlain
Manager of Sales
RECEIVER DIVISION

10

*Patent applied for

THE Chemical CORPORATION
54 Waltham Ave., Springfield 9, Mass.

THE CHEMICAL CORPORATION
54 Waltham Ave., Springfield 9, Mass.

Please send me full particulars about Luster-on* bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

Name.....

Address.....

Monthly Review — March

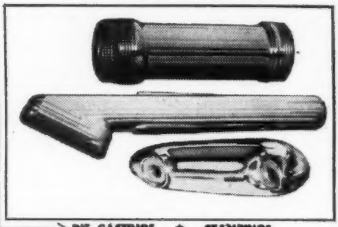
Use this Chart

TO DETERMINE THE RIGHT COMPOSITION TO USE ON ALL BUFFING AND POLISHING OPERATIONS—HAND OR AUTOMATIC.

Standard Methods and Specifications for Stevens Buffing Compositions

MATERIAL	POLISHING		BUFFING		FINISHING	
	On Set-up Wheels	On Bulls	Hand Buffing	Automatic Machine	*Bright (Mirror)	Semi-bright (Satin, etc.)
Aluminum						
Castings	#2 Tallow		#20 Tripoli	#12 Tr.	FC Colg.	M Greaseless
Forgings	#2 Tallow		#70 Tripoli	#2 D. D.	HL Colg.	F Greaseless
Stampings			#73 Tripoli	#12 Tr.	HL Colg.	F Greaseless
Brass						
Castings	#1 Tallow	M Greaseless	Reg. #1 Trip.	#70 Tr.	HL Colg.	M Greaseless
Forgings	#2 Tallow	F Greaseless	Marvel. Trip.	#100 Tr.	HL Colg.	F Greaseless
Stampings			Marvel. Trip	#100 Tr.	HL Colg.	F Greaseless
Celluloid			Plasticut	#472 Colg.	Plasticolor	
Copper			#8 D. D.	#12 Tr.	HL Colg.	F Greaseless
Die Castings			#20 Trip.	#14 Tr.	FC Color	F Greaseless
Iron	#1 TS & Em. C.	C Greaseless	Calmore Tr.	#408 St.	#181 White	C Greaseless
Leather			#8 D. D.		HL Colg.	Tampico Comp.
Pewter			#100 Tr.		AB Colg.	F Greaseless
Plastics						
Soft Types			Plasticut		Plasticolor	
Hard Types			Reg. #1 Tr.		#181 White	
Block Types			#16 Block		#16 Block	
Plated Surfaces						
Cadmium					White Rose	
Chromium					#1033 Chr.	#67 Greaseless
Copper			#8 D. D.	#8 D. D.	HL. #680	
Gold					Ace Rouge	
Lead					White Rose	
Nickel			FF #13 Lime	FF #14 L.	HL. #680	#68 Greaseless
Silver					FX Rouge	#67 Greaseless
Tin					Crocus	
Zinc					White Rose	
Platinum			#20 X White		Green Plat.	
Rubber (Hard)			#16 Black	Reg. #1 Tr.	#16 Black	
Silverware						
Hi-Silver			#12 Trip	#100 Tr.	Ex. Rouge	#67 Greaseless
Sterling			#3 Trip.	#100 Tr.	12 X Rouge	#67 Greaseless
Steel						
Carbon	#1 TS & Em. C.	C Greaseless	#408 St.	#400 St.	#181 White	M Greaseless
Stainless	#4 Tallow	F Greaseless	#403 St.	#20 St.	#29 X White	F Greaseless
White Metal	#4 Tall. & Em. C.		#8 D. D.		HL Colg.	
Wood			Reg. #1 Tr.		#8 D. D.	

ALUMINUM COOKING UTENSILS



DIE CASTINGS * STAMPINGS

STERLING * SILVER PLATE

A large print of the above Chart is reproduced on Page 16 of our No. 27 Catalog. If you do not have a copy, one will be mailed to you upon request.

For time and labor saving results use this Chart for determining the right composition to use on various metals and for all operations—hand or automatic.

The three illustrations, with Chart references, show how easily you can determine the composition best suited to give desired results.

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• 2365 Dundas St. West — Toronto, Ontario

BUFFING COMPOSITIONS • METAL POLISHERS AND ELECTROPLATERS SUPPLIES-EQUIPMENT

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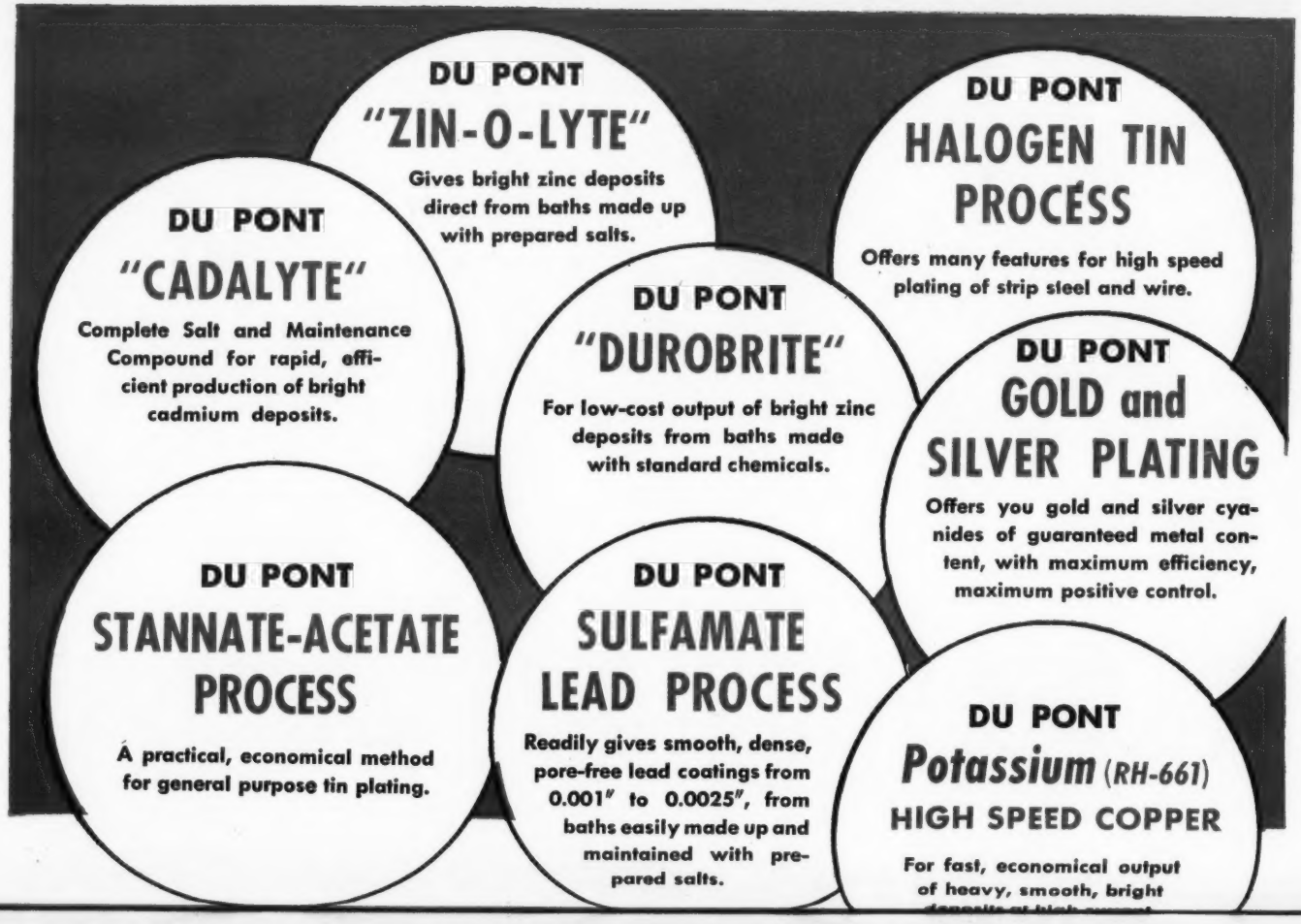
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"ZIN-O-LYTE"
Gives bright zinc deposits direct from baths made up with prepared salts.
DU PONT
HALOGEN TIN PROCESS
Offers many features for high speed plating of strip steel and wire.
DU PONT
"CADALYTE"
Complete Salt and Maintenance Compound for rapid, efficient production of bright cadmium deposits.
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"DUROBRITE"
For low-cost output of bright zinc deposits from baths made with standard chemicals.
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Offers you gold and silver cyanides of guaranteed metal content, with maximum efficiency, maximum positive control.
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A practical, economical method for general purpose tin plating.
DU PONT
SULFAMATE LEAD PROCESS
Readily gives smooth, dense, pore-free lead coatings from 0.001" to 0.0025", from baths easily made up and maintained with prepared salts.
DU PONT
Potassium (RH-661)
HIGH SPEED COPPER
For fast, economical output of heavy, smooth, bright

NO OTHER LINE OF PLATING PROCESSES

maintained with prepared salts.

For fast, economical output of heavy, smooth, bright

NO OTHER LINE OF PLATING PROCESSES OFFERS YOU SO MANY ADVANTAGES!

ADOPT Du Pont Electroplating Processes, Chemicals and Anodes for plating at maximum speed and efficiency, giving best results at minimum cost. In addition to the processes outlined above, there are many other Du Pont Processes to choose from—enabling you to pick the process best suited to your exacting requirements. To help you further, Du Pont Technical Service offers: essential data on many types of plating; results from years of electroplating research in the laboratory and in the field; specific technical literature on selection, installation and operation of plating processes; assistance with your specific problems. Write us *now* about your needs! E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

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Wilmington 98, Delaware

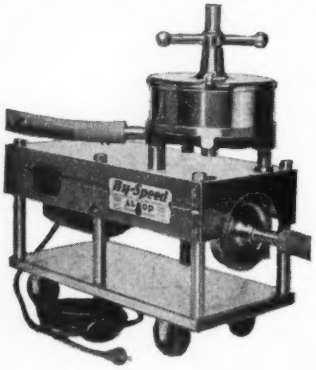
Please send me the following (check which) Operating Manual (s):

- ☐ RH-661 High Speed Copper
- ☐ "Cadalyte" for Cadmium Plating
- ☐ "Zin-O-Lyte" Zinc Plating
- ☐ "Durobrite" Zinc Plating
- ☐ Halogen Tin Process
- ☐ Stannate-Acetate (Tin) Process
- ☐ Electrodeposition of Gold and Silver
- ☐ Sulfamate Lead Plating

Name _____

Address _____

City _____



Check ✓ THESE FEATURES

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New DISC FILTERS

OFFER THESE DISTINCT ADVANTAGES

✓ Completely enclosed, air-tight unit, eliminating loss through leakage or dripping.

✓ Exceptionally small space requirement. For example, a 600 gals. per hour filter complete with electric pump requires only a 9″ x 20″ floor space — a 2000 gals. per hour machine requires only 12″ x 24″ of floor space.

✓ Filter discs can be changed quickly and easily even when changing from one solution to another. Anyone can do it in a very few minutes.

✓ Made in sizes, with or without pumps, from 1 gal. per minute up to thousands of gals. per hour.

ALSOP

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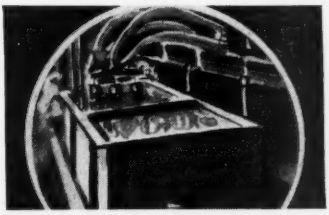
Our Engineering Service plus our Laboratory facilities have been very helpful to many of our customers. Perhaps we can help you, too. We'd like to try. Just write us giving details of solutions to be filtered, there's no obligation.

LO·HI pH

SIGNIFICANT to PERFECT BOND

The "Lo-Hi" process of cleaning metal preparatory to plating consists of both a low pH and a high pH solution, in separate tanks (two baths) to provide for the thorough removal of soil regardless of the degree of alkalinity or acidity. What the one bath doesn't get the other does. This method assures a chemically clean surface preparatory to plating and makes practical a control in the plating room that provides management with what-to-plan-on the rest of the way in production.



LO·HI pH

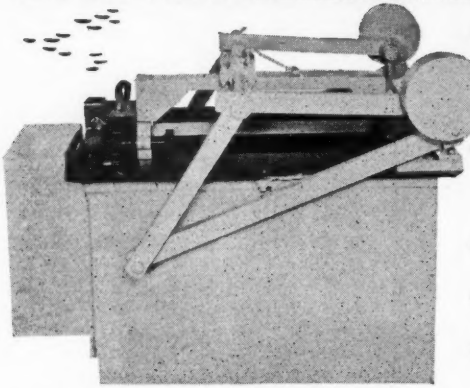
NORTHWEST CHEMICAL CO.

9310 ROSELAWN DETROIT 4, MICH.

pioneers in pH cleaning control—serving you since '32

FOR FAST PLATING...

Lasalco's New Intermediate Barrel Plater



Nothing Plates But the Load

- Serves for all jobs requiring capacities between a small utility plater and regular size Richards Barrel Plater.
- Just the *right* size for alkaline or acid solutions
- Built for quick loading and unloading
- Maximum flexibility for many jobs
- Requires less operating effort than other barrel platers
- Carefully counterbalanced for easy handling
- Speeds up and increases production
- Can be used for a still plating tank
- Unloading trays are not necessary
- Cylinder and gears made of hard rubber

QUICK AND EASY LOADING

- Note how cylinder is swung forward and head is held in position for loading.
- Switch type negative contact is made automatically when cylinder is lowered into tank.
- Insulated negative connection through hollow hub of cylinder prevents interference while loading or unloading.

SIMPLIFIED TIME-SAVING UNLOADING

- Automatically placed in position for unloading, cylinder is secured by handle and ratchet arrangement. Load can be emptied right into tote baskets — unloading trays are not necessary.

⅛ h.p. motor; 3 speeds—2, 4 or 12 r.p.m.; inside dimension of cylinder—10" dia. x 18"; capacity 8 qts., or 30 lbs., maximum; constructed with steel tank for cyanide solutions, or rubber lined tank for nickel solutions.

LASALCO, INC.

2818-38 LA SALLE STREET • ST. LOUIS 4, MISSOURI

You've got to go

ALL THE WAY

to Get Results

Quality plating calls for clean metal, of course — but it also depends on a clean plating bath. In fact, unless the bath is *continuously clean,* pitting, spotting and poor adhesion are almost sure to follow and your work will fall short of the mark.

Darco S-51 is especially made to keep plating baths continuously clean. Through the process of adsorption, Darco activated carbon purifies the solution — removes grease, oil, soap, colloids, decomposition products — impurities that result in defective plating.

Darco activated carbon is a fine black powder, employed in conjunction with a filter. It does a big job at small cost and is used in the plating baths of many metals — bright nickel, cyanide zinc, cadmium, copper, iron, gold, silver.

For detailed directions, send for a copy of "Physical Removal of Impurities from Plating Solutions." Write for suggestions if you have special problems.

(This trademark identifies the genuine. Accept no packages without it.)

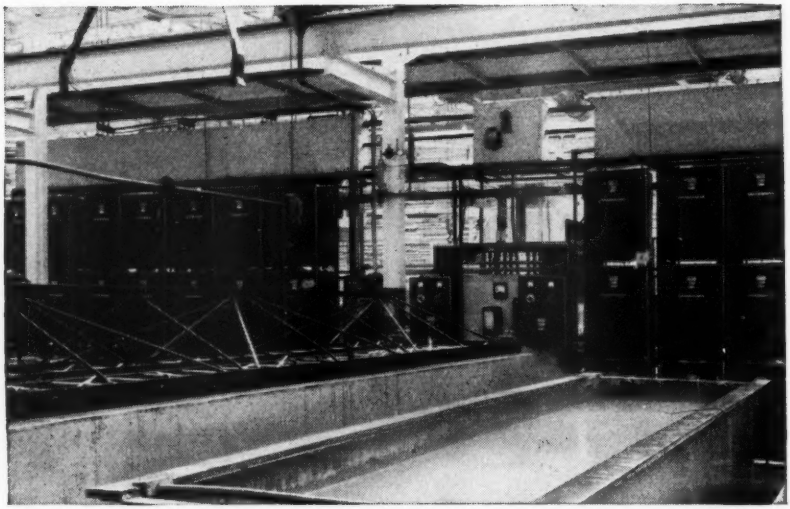
DARCO

DARCO CORPORATION

60 E. 42nd Street, New York 17, N. Y.

DARCO—REG. U. S. PAT. OFF.

Is Your Plating Bath as Clean as the Water Used in Your Final Rinse?



FOR A FLEXIBLE PLATING POWER SUPPLY USE *G-E* RECTIFIERS . . .

Equip your plating shop with G-E Copper-oxide Rectifiers. It's a sure way to eliminate the expense, costly delays and shutdowns which so often result when production needs change.

They Help You Save Five Ways:

1. G-E COPPER-OXIDE PLATING RECTIFIERS offer a decentralized power source that can be shifted easily and quickly to the exact spot required for peak operating efficiency.
2. G-E COPPER-OXIDE PLATING RECTIFIERS can be arranged in parallel, series or series-parallel for a wide range of voltage and current requirements.
3. G-E COPPER-OXIDE PLATING RECTIFIERS supply transmission control of a-c input instead of resistance control in d-c output. This cuts current cost to the minimum.
4. G-E COPPER-OXIDE PLATING RECTIFIERS are easy to install. They require no special foundation or expensive installation accessories.
5. G-E COPPER-OXIDE PLATING RECTIFIERS have no moving parts other than a ventilating fan which requires occasional lubrication. Hence, maintenance costs compared with other types of plating power equipment are negligible.

Investigate how G-E Copper-oxide Rectifiers can help you realize economies in your plating and anodizing establishments. Write to Section A264-106, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. Ask for a copy of our catalog entitled, "G-E Copper-oxide Plating Rectifiers and Controls."

GENERAL ELECTRIC

45,000 PIECES PER SHIFT

FINISHED WITH

BLACK-MAGIC

In this Gigantic Assembly

View shows but one end of this series of six tanks, over which the work is carried and dipped by automatic conveyor. Installation has been in use over two years at the plant of Everedy Co., Frederick, Md. — turning out as high as 90,000 Black-Magic processed pieces a day (2 shifts)! Black-Magic was chosen here, as in hundreds of other plants, solely on competitive test. Points that helped decide the choice: dense blackness, deep penetration, flexibility, rust inhibition, paint bonding ability, etc. Send for the "Black Book" — it tells all!

SILCO

GLASS-BASE PROTECTIVE SPRAY COAT

Excellent protective and ornamental coating for steel lockers, mufflers, stove and heater parts and other steel and brass articles. Spray it on and dry at 200° F. Then bake at 350° F. in any industrial oven. Beautiful colors. Stands heat up to 1000° F. Resists corrosion, abrasion and impact. Send for sample and details.

MITCHELL-BRADFORD CHEMICAL COMPANY

MODERN METAL FINISHES

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CONVENTION *News*

PLANS for the 1946 Convention in Pittsburgh have progressed to the point at which it is possible for Educational Chairman, R. A. Dimon to announce the following tentative schedule of the Educational Sessions:

Monday — Morning — Opening session; Afternoon — Miscellaneous Papers

Tuesday — Morning—Symposium on Strip and Wire Plating. Afternoon — Held open for Plant Visitations

Wednesday — Morning — Symposium on Organic Finishes. Afternoon — Research Committee Reports

Thursday — Morning — Miscellaneous Papers; Afternoon — Annual Business Meeting

The Miscellaneous Sessions will include papers on electropolishing, bonderizing, copper deposition, wartime developments in electrodeposition in Great Britain and other general topics. It should be noted that any part of this schedule is subject to revision if circumstances require, but every effort will be made to adhere to it as closely as possible.

The Registration Committee under Leo J. Schmitt is setting up an efficient method of registration that will eliminate all unnecessary delay and thus give everyone the opportunity of being present at the opening ceremonies.

It is expected that an announcement concerning the method of making hotel reservations will be made in the next issue of the REVIEW.

WILLIAM J. HENNESSY,
Publicity Chairman,
A.E.S. Convention

McKeon Sees Beneficial Publicity From Convention Exhibit

Wilfred S. McKeon, Chairman of the Committee on Exhibits for our 33rd Annual A.E.S. Convention, when interviewed by a representative of this publication the other day gave out the following statement:

"Exhibits? Say Brother, the exhibits at convention alone will justify your making the trip from your home to Pittsburgh.

"We are going to make a play — not only that the registrants at the Convention shall be interested in our exhibits but these exhibits will be so interesting and fascinating that Johnny Q. Public of the Golden Triangle of Pittsburgh will be there to see them too. And that won't do the plating industry a bit of harm either.

"The whole industry understands that a little publicizing will always do any industry or anything else plenty of psychological good. The more thousands of people who become conversant with the electrodeposition of metals, the better it is for everybody in the game.

"We will have exhibits coming in from The California Golden Gate, also some entries which were prize winners at the last conference in Cleveland. (These exhibits will be marked — 'NOT IN COMPETITION, — having won a prize at a previous conference.')

"The motif, generally speaking, for the exhibits is epitomized in the following: 'HALL OF PLATERS' CONTRIBUTION TO OUR SUCCESSFUL WAR EFFORT.'

"The above caption will welcome you to the 17th floor's Adonis Room in the William Penn at the Pittsburgh Convention.

"See you in June — A.E.S. Convention — Pittsburgh."

— MAKE YOUR CONVENTION PLANS NOW! —

RESEARCH COMMITTEE MEETING

THE A.E.S. Research Committee held a meeting at The Palmer House, Chicago, Friday, January 18, 1946. The following members and guests were present:

Dr. R. M. Wick, E. T. Candee, W. A. Wesley, M. R. Caldwell, F. K. Savage, W. M. Phillips, F. C. Mesle, A. K. Graham, W. L. Pinner, K. M. Huston, F. C. Clifton, R. J. McKay and C. H. Sample. Dr. William Blum was unable to attend because of illness.

The meeting was called to order at 10 A.M. with C. E. Heussner presiding. After approval of the minutes of the previous meeting, September 22, 1945, the Committee voted its approval of depositing $5,000.00 of the A.E.S. Research Fund in the Philadelphia Savings Fund Society.

The Committee then passed a motion authorizing the Chairman and Secretary to deposit additional A.E.S. Research Funds in amounts not to exceed $5,000.00 in any institution which is covered by Federal Deposit Insurance in this amount and pays interest on deposits. Such institutions may be located in different sections of the country. The total amount so deposited must be limited so as to permit maintenance of an adequate working balance in the active account.

Dr. R. M. Wick, Chairman of the Research Directing Sub-Committee, then reported on the eight projects of this Committee. Details of these projects have been published in a previous issue of the REVIEW and will not be repeated here.

The Chairman appointed a Policy Committee, consisting of E. T. Candee, Chairman, W. M. Phillips and F. K. Savage, to prepare a report on policy matters for consideration by the Committee at its next meeting.

The Executive Secretary reported that a reprint of Parts I to III of the report on Project No. 3, "Methods of Testing Adhesion", would be available soon. Parts IV and V will be available in reprint form after they have appeared in the REVIEW.

Reprints of the reports on Projects No. 1 and No. 2, as they appeared in the July and August issues of the MONTHLY REVIEW, will not be prepared. This material in revised form will be made available later.

A standard cover for A.E.S. research reprints is being prepared.

M. R. Caldwell, Chairman of the Finance Sub-Committee, reported that 127 Sustaining Members had been obtained and an additional 16 memberships were known to be promised. He emphasized the importance of continued effort in order that the goal of 400 Sustaining Members for this year be reached. He corrected a misunderstanding and stated that subscriptions to the A.E.S. Research Fund of less than $100.00 are welcome but do not entitle a subscriber to the advantage of Sustaining Membership.

The Secretary was asked to compile a list of the Branches which have increased their dues to permit assignment of $1.00 per year per member as subscription to the Research Fund.

The Committee adopted a set of By-Laws, published elsewhere in the REVIEW.

The next meeting of the Research Committee will be held in Philadelphia at the Benjamin Franklin Hotel at 9:30 A.M., Friday, April 5, 1946.

A. KENNETH GRAHAM,
Executive Secretary

Harshaw Announces New Single Nickel Salts

By a unique process the Harshaw Chemical Company announces it can produce single nickel salts in small definite crystals of carefully controlled size. In comparison with larger crystals formerly produced, the advantage claimed for the small crystals are:

Rapid solubility because of the large surface area, freedom from lumping and caking under reasonable storage conditions, and higher purity high nickel content. These new salts with the formula $NiSO_4 \cdot 6H_2O$ make possible the use of strong 5-ply paper bags, 100 lb. net, which stack easily and pour in a free flowing stream. Details on request to the company.

WHO SHOULD SUPPORT THE RESEARCH PROGRAM?

THE Research Program now in operation costs approximately $40,000 annually. It represents a very progressive step forward, one that we are all proud of. As technical information derived therefrom is made available in ever increasing quantities, you as a member will agree that we will all profit.

This benefit to each and every one of us will come in many ways. Some will profit directly when research data are applied to improve a condition in the plant. Others will gain more indirectly, for example by increased application of electroplating as a result of the development of better testing methods for process solutions and finished products.

Each investigation is begun by an extensive survey of the literature on the subject in question. Following the completion of the survey, the project director digests the information and publishes it in the REVIEW. He then continues with actual research in an effort to solve the problem at hand. The literature survey and the results of the research are yours as a member of A.E.S.

It is evident that all of us have a stake in this work. Since the concerns which employ us will benefit, we are striving to have them join our ranks as Sustaining Members. Four-hundred Sustaining Memberships is our goal. As a plater, electrochemist, engineer or sales representative, you have a personal benefit to derive. Therefore, the members of the Research Committee feel that each one of us should support the work.

Several Branches subscribed to the work last year. Some voted an increase in the annual dues of $1 to cover the cost. My plea to you is for more individual support. If all of us subscribe $1 annually, we will collect a total of $4,400. This amount would go a long way in supporting one of the eight projects now under way.

A letter is being mailed to each Branch Secretary on this subject. Discuss it at your next meeting. Your favorable action will be appreciated. All Branches supporting the work will be given due credit in our reports.

The Branches which have supported the program to date are:

Boston	$100.00
Buffalo	100.00
Chicago	335.00
Dayton	100.00
Detroit	407.00
Grand Rapids	127.00
Lancaster	50.00
Los Angeles	200.00
Milwaukee	100.00
Newark	200.00
New York	200.00
Philadelphia	197.00
Pittsburgh	79.00
Providence-Attleboro	100.00
Rochester	100.00
San Francisco	77.00
Syracuse	100.00
Toronto	125.00
Waterbury	225.17

MAURICE R. CALDWELL, *Chairman, Sub-Committee on Finance*

Safety Directory and Catalog

A complete safety directory and catalog, under the title of "Best's Safety Directory and Catalog" planned for distribution in the fall of 1946 will give a complete, illustrated compilation of all Safety, Hygiene, First Aid and Fire Protective products and devices. Manufacturers of safety equipment will be listed together with a geographical list of local dealers and distributors. The book will be completely cross indexed and profusely illustrated to give quick answers to the questions of "what to use; in what specific hazardous situation to use it; who manufactures it and where to get it."

The First Annual Edition will be ready in the fall of 1946. Copies can be reserved for limited printing order, $5.00 postpaid from the publishers, Alfred M. Best Company, Inc., 75 Fulton Street, New York 7, N. Y.

By Laws of
The A. E. S. Research Committee

Article I — Authority

Sect. 1. Authority: The Research Committee is created under the authority given in Part I, Article IV, Sect. 6 of the By-Laws of the American Electroplaters' Society, hereinafter referred to as the Supreme Society.

Article II — Meetings

Sect. 1. Time and Place: Meetings shall be held at least four times a year upon stated days at times and places approved by the majority of the members. The final meeting shall be held immediately prior to or at the time and place of the Annual Convention of the Supreme Society.

Sect. 2. Object: The meetings shall be for the establishment of policies pertaining to new research projects, research projects in progress, publication of project reports, solicitation of sustaining memberships, collection and disbursement of research funds, and all other matters which rightfully are a function of a Research Committee.

Article III — Election of Officers

Sect. 1. Chairman and Vice-Chairman: The Chairman and Vice-Chairman of the Research Committee for the fiscal year shall be elected prior to the end of the preceding fiscal year at a meeting of the Committee or by letter ballot.

Sect. 2. Secretary: The duly appointed Executive Secretary of the Supreme Society shall serve as Secretary of the Research Committee.

Article IV — Duties of Officers And Functionaries

Sect. 1. Chairman: It shall be the duty of the Chairman to preside at all meetings, to preserve order, to put all duly seconded motions before the meeting, to decide all questions of order subject to an appeal to the meeting, and to cast the deciding vote in case of a tie. In the absence of an officer, he shall appoint a member to act during his absence. He shall make all appointments not otherwise provided for, and in honor of his office, be a member of all sub-committees. Following the appointment of new Research Committee members at the Annual Convention of the Supreme Society, he shall appoint for one year Chairmen of Research Sub-Committees. He shall execute all contracts binding on the Research Committee.

Sect. 2. Vice-Chairman: It shall be the duty of the Vice-Chairman to perform the duties of the Chairman in his absence, upon his death or resignation and assist the chairman as directed by him.

Sect. 3. Chairman of the Research Directing Sub-Committee: Subject only to the advice of the Research Committee as a whole, the Chairman of the Research Directing Sub-Committee shall have active charge of the conduct of all research projects, negotiate for and assign research projects to various institutions, determine proper remuneration for research personnel and appoint a Vice-Chairman and Project Sub-Committees to supervise the research work. The decisions pertaining to the subject and scope of research projects shall be made by vote of the Research Committee as a whole.

Sect. 4. Vice-Chairman of the Research Directing Sub-Committee: It shall be the duty of the Vice-Chairman of the Research Directing Sub-Committee to perform the duties of the Chairman in his absence and assist the Chairman as directed by him.

Sect. 5. Project Chairman: It shall be the duty of the Project Chairman to supervise the work of the Project Director assigned to him and his Project Committee, to report to the Research Directing Sub-Committee on the progress of research work, to edit reports of the Project Director, and to perform any other duties assigned to him by the Chairman of the Research Directing Sub-Committee.

Sect. 6. Project Director: It shall be the duty of the Project Director to conduct a research project as directed by the Chair-

man of the Research Directing Sub-Committee and the Project Chairman. The Project Director may be under contract to the Research Committee.

Sect. 7. Chairman of the Research Finance Sub-Committee: It shall be the duty of the Chairman of the Research Finance Sub-Committee to solicit sustaining memberships for the Supreme Society and other subscriptions, and to assist the Research Committee representative of each Branch Society in such work. He shall direct that fees for sustaining memberships and subscriptions be sent to the Secretary, and shall furnish other information required for the maintenance of the financial and sustaining membership records in the office of the Secretary.

Sect. 8. Secretary: In addition to the duties outlined in the Constitution and By-Laws of the Supreme Society, the Secretary shall submit bills for annual dues to the sustaining members appearing on the list furnished him by the Chairman of the Research Finance Sub-Committee, submit to the members of the Research Committee and to the Finance Committee and Executive Board of the Supreme Society monthly statements of subscriptions received to the Research Fund, and furnish a current financial statement of the condition of the Research Fund to each regular meeting of the Research Committee.

Sect. 9. Reports: The Sub-Committee Chairmen and the Secretary shall present reports of their work at each meeting and shall submit annual reports to the Chairman of the Research Committee to be incorporated in the Annual Report of the Research Committee to the Supreme Society.

Article V — Miscellaneous

Sect. 1. Resignations: Any member of the Research Committee intending to resign shall give written notice to the President of the Supreme Society with a copy to the Chairman of the Research Committee. A new member will be appointed by the President of the Supreme Society to fill the unexpired term of the member resigning.

Sect. 2. A.S.T.M. Liaison: To promote closer coordination between the activities of the committees of the respective Societies, the Chairman of the Research Committee shall request the Chairman of A.S.T.M. Committee B-8 or its successor, to appoint a member of A.S.T.M. Committee B-8 to the meetings of the Research Committee. The Chairman of the Research Committee shall request permission for an appointee of the Research Committee to attend meetings of A.S.T.M. Committee B-8.

Robert L. Buckley Forms Own Company

Robert L. Buckley has resigned his position as consulting chemist and plating engineer of E. R. Frost Company, Minneapolis, Minn. and formed the Industrial Chemical and Equipment Company, 318 Builders Exchange, Minneapolis, Minn.

Mr. Buckley has studied chemistry in the Twin Cities and entered the chemical electroplating field with the Cornelius Company, Minneapolis. The new company will serve as sales representatives for manufacturers of electroplating and chemical processing equipment and supplies. Mr. Buckley is Secretary-Treasurer of the Twin City Branch of the American Electroplaters' Society.

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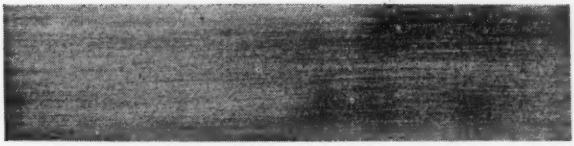
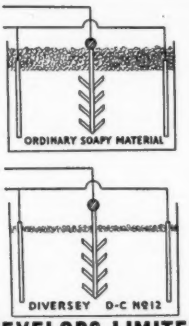


Reverse Current Cleaning of Brass with D-C No. 12

Reverse Current Cleaning of Brass with Soapy Material



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Diversey D-C No. 12 develops a LIMITED foam blanket on the surface of the bath. Irritating solution spray in the room is thus prevented, while danger of hydrogen explosions encountered with heavy foam blankets is practically eliminated.

Specially developed for electro cleaning, Diversey D-C No. 12 is quickly and completely soluble in water and practically odorless. Has high emulsifying and wetting properties, is free-rinsing in cold water, and prevents hard water deposits from settling on the work and tank. Because of its high conductivity, D-C No. 12 conserves current . . . is economical, too, because of its longer solution life than ordinary electro cleaners.

Diversey D-C No. 12 is recommended for removing light oil film with smut and dirt . . . for removing heavy contaminations following still tank cleaning . . . for removing polishing and abrasive compounds following solvent precleaning . . . for cleaning copper alloys without danger of forming soap films . . . for removing pickling smut . . . and for cleaning printing plates.

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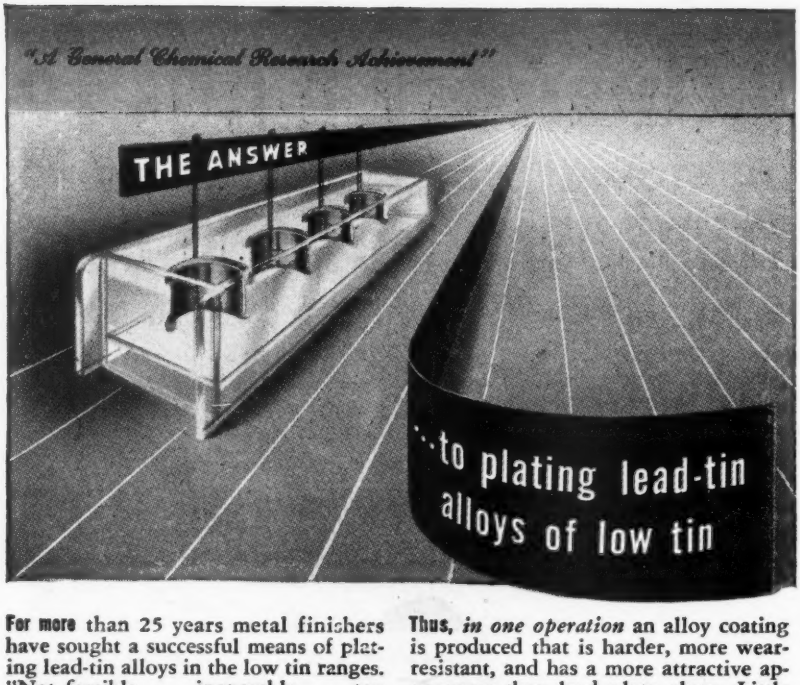

For more than 25 years metal finishers have sought a successful means of plating lead-tin alloys in the low tin ranges. "Not feasible . . . inoperable . . . too many variables," read published reports on method after method.

Now—with the new chemical tools of General Chemical Fluorine Research—platers are achieving the "impossible."

Here's how: General Chemical *Lead* and *Tin Fluoborate solutions* are thoroughly compatible. Combined in baths using dual or alloy anodes, they plate dense, fine-grained lead-tin alloy deposits uniformly, simultaneously, and *with the tin easily controlled at low ranges!*

Thus, *in one operation* an alloy coating is produced that is harder, more wear-resistant, and has a more attractive appearance than lead plate alone. Little wonder that leaders in the bearing industry are adopting the combination fluoborate bath for lead-tin alloy plating of their products!

"First in Fluorides" For working samples of General Chemical's Lead, Tin, or other fluoborate solutions—for sound, practical information on their applications, based on the research and "know how" of America's foremost producer of fluorine compounds—contact the nearest General Chemical Sales and Technical Service Office or write General Chemical Fluorine Division, 40 Rector Street, New York 6, N. Y.

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Lead-Tin ALLOY PLATING

By A. E. CARLSON and J. M. KANE

General Chemical Company, New York, N. Y.

SUMMARY

THIS article presents newly developed information on methods of plating lead-tin alloys containing any desired amount of tin from 5% to 60%. Details are given for the use of separate lead and tin anodes in the deposition of low tin-high lead alloys, and for the use of alloy anodes. Necessary modifications for the successful plating of bearings are discussed. Some typical applications of lead-tin alloy coatings are listed.

INTRODUCTION

Protective coatings of lead-tin alloy, known as terne plate, have been applied to steel by the hot dip method for many years. Electrodeposition of the lead-tin alloy was first mentioned by Groff who, during World War I, developed a procedure for plating a 50-50 alloy from the fluoborate bath for lining the inside of air flasks used in torpedoes. The plating bath was prepared by electrolyzing a lead fluoborate bath with tin anodes until the desired tin content was obtained. Subsequent work was carried out in 1921 by Haring and Blum of the National Bureau of Standards. These investigators found it relatively simple to deposit alloys containing approximately 50% lead and 50% tin. However, it was not found feasible to plate alloys with less than 25% tin because, in the solutions required to produce such deposits, the potentials of lead and tin are sufficiently different that the corresponding alloy anodes corrode irregularly and thus change the composition of the solution.

The increasing commercial use of electrodeposited lead-tin alloy made desirable a simple, reliable method for plating in the lower ranges of tin. As a result of extensive investigations, a method has been developed by means of which lead-tin alloy, containing any desired amount of tin from 5% to 60% may be plated with a high degree of uniformity.

Lead-tin alloy may be plated successfully by using either dual anodes or alloy anodes. Dual anodes refer to the use of separate anodes of pure tin and of pure lead, the current flow to each being controlled separately. Alloy anodes are composed of lead and tin in predetermined ratios. In certain applications the dual anode method may have definite advantages. However, for most lead-tin alloy plating, the alloy anode method is preferred because it is simpler to use. The details of both methods are presented herein.

PROPERTIES OF CONCENTRATES

The electrolyte employed in the deposition of lead-tin alloy consists of a solution of lead fluoborate and tin fluoborate, to which is added an addition agent.

The metal fluoborates of lead and tin are marketed as clear, colorless solution concentrates. The lead concentrate contains about 50% lead fluoborate, 5% free boric acid and 5% free fluoboric acid. The tin concentrate contains about 47% tin fluoborate, 3% free boric acid and 4% free fluoboric acid.

The solutions are thoroughly compatible in all proportions, and may be diluted with water to any desired concentration.

PROCEDURE WITH DUAL ANODES

The details for plating by the dual anode method have been developed only for deposits containing 90% lead and 10% tin. Presumably, alloys of any other composition could be plated if appropriate changes were made in the bath composition and operating conditions. The dual anode method is capable of producing a deposit of precise composition, but only at the expense of control of a greater number

of variables. Bath composition, acidity, temperature and current density are the same for the dual anode and the alloy anode methods. In addition to these factors, in the dual anode method it is necessary to control the surface areas of the lead and tin anodes as well as the currents impressed on the anodes.

General Plating Conditions

The following conditions, which have been found satisfactory for plating a 90% lead-10% tin deposit, are typical for lead-tin alloy plating with dual anodes.

Bath Composition	*g/l*	*oz/gal*
Total tin	10.0	1.3
Stannous tin	9.0	1.2
Lead	90.0	12.1
Free fluoboric acid	40.0	5.4
Free boric acid	25.0	3.4
Glue	0.5	.067

Operating Conditions

Temperature 70-100°F

Current cathode density 30 amp/sq. ft.

Anodes

Ratio of tin to lead areas 1:5

Ratio of anode to cathode areas 2:1

Ratio of currents on tin and lead 1:7

Anode Control

The tin in the deposit is controlled by the amount of tin in solution, which in turn is determined by the surface area of the tin anodes and by the impressed amperage on the tin anodes. Thus it is possible, within certain limits, to control the percentage of tin in the deposit by varying the area of the tin anode and the amperage on it.

For a 90% lead-10% tin deposit it was found that the ratio of areas of the tin and lead anodes should be at least 1:5 and may safely go as high as 1:7. Too large a tin anode area results in increased tin content of the solution and the deposit.

The distance between each tin and lead anode in the bath should be 2 to 3 inches.

Current Control

The following example illustrates the manner in which current density is controlled in the dual anode method. Assuming that the cathode area is 1 sq. ft., the total anode area, i.e. the area of the tin anodes plus the area of the lead anodes, should be twice as large, or 2 sq. ft. With a cathode current density of 30 amp/sq. ft., the anode current density would then be 15 amp/sq. ft. If the currents impressed on tin and lead anodes are in the ratio of 1:7, then the tin anodes will receive ⅛ of 30 amperes, or approximately 2 amp/sq. ft., while the lead anodes will receive ⅞ of 30 amperes, or approximately 13 amp/sq. ft.

The procedure for preparing and operating a bath with the dual anode method is the same as that given under the alloy anode method and will be presented under that heading.

BATH OPERATION

In Table I are presented a series of tests which illustrate the influence of various factors upon the composition of the deposit. These influences are not so great as to render the method critical, but nevertheless they affect the composition. Each series shown represents the average of a number of separate tests.

TABLE I

DUAL ANODE PLATING

	Current Density					Bath Composition				
Series	Ratio Anode Areas Tin:Lead	Ratio Impressed Currents Tin:Lead	Cathode Amp/sq.ft.	Anode Amp/sq.ft.	Temp. °F	Agitation	Total Tin g/l	Stannous Tin g/l	Lead g/l	Deposit Composition % Tin
A	1:5	1:7	30	15	73.5	Mild	10.3	8.1	89.1	9.8
B	"	"	"	"	97.5	"	10.6	8.4	89.1	11.4
C	"	"	"	"	73.5	"	11.2	9.3	90.9	11.1
D	"	1:4	"	"	75	"	12.5	10.3	88.8	11.6
E	"	"	15	7.5	73	"	13.1	11.1	89.7	11.2
F	"	"	"	"	70	Vigorous	13.9	11.9	90.4	12.9
G	"	"	30	15	73	"	13.4	11.8	90.5	14.8

A comparison of Series A with Series B, where *temperature* is the variable shows that an increase in temperature of the bath tends to increase the proportion of tin in the deposit.

Comparing Series A with Series C, *total tin* in the bath being the variable, one finds an increase in tin concentration in the bath results in increased tin in the deposit. It will be noted that the stannous tin content increases as the total tin increases.

Series D may be compared with Series G to show the effect of agitation. With a cathode current density of 30 amp/sq. ft., an increase in the degree of agitation causes an increase in the tin content of the deposit. Part of this increase may be attributed to the slight increase in the total tin content of the bath, but the major fraction is due to the more vigorous agitation.

The effect of agitation is further demonstrated by a comparison of Series E with Series F. In these tests, carried out with a cathode current density of 15 amp/sq. ft., the use of the more vigorous agitation resulted in an increase in the tin content of the deposit. The increase in tin content is less with 15 amp/sq. ft. than with 30 amp/sq.ft., indicating that the applied current density can also influence the composition of the deposit.

A comparison of Series F with Series G demonstrates the effect of *current density*. An increase in cathode current density from 15 amp/sq.ft to 30 amp/sq.ft. resulted in a definite increase in the tin content of the deposit.

Summarizing these results we find that an increase in (1) temperature, (2) total tin in the bath, (3) agitation, and (4) current density all tend to increase the percentage of tin in the deposit.

The *ratio of impressed amperages* on the tin and lead anodes influences the rate of solution of the anodes, resulting in a change in tin content of the deposit. This is shown by Series D, which employ the same bath as was used in Series C, but with ratio of impressed amperages of 1:4 instead of 1:7. It will be noticed that with the increased amperage on the tin anodes, the tin content of the bath increases, causing a corresponding increase in the percentage of tin in the deposit. The ratio of 1:7 was finally established as being optimum for the particular set of conditions necessary to produce a deposit of 90% lead-10% tin.

PROCEDURE WITH ALLOY ANODES

The greater ease of control which results from the use of alloy anodes makes this method preferable for most lead-tin alloy plating.

For plating lead-tin alloy of any ratio up to 60% tin, there are two important variables: (1) the lead-tin ratio in the alloy anode, and (2) the lead and tin contents of the bath.

Table II shows the approximate composition of both the anode and the bath recommended for various lead-tin deposits up to 60% tin.

TABLE II

COMPOSITION OF ANODE AND BATH FOR VARIOUS DEPOSITS

Deposit and Anode Composition, %		Bath Composition in Grams per Liter					
Tin	Lead	Total Tin	Stannous Tin	Lead	Free HBF_4	Free H_3BO_3	Glue
5	95	5	4	90	40	25	0.5
7	93	7	6	90	40	25	0.5
10	90	10	9	90	40	25	0.5
15	85	15	13	80	40	25	1.0
25	75	25	22	65	40	25	1.5
40	60	40	35	44	40	25	3.0
50	50	50	45	35	40	25	4.0
60	40	60	55	25	40	25	5.0

This table is based on the use of a cathode current density of 30 amp/sq.ft., alloy anodes with area twice the cathode area, and with the bath at room temperature, with mild agitation.

It will be noted that the lead and tin content of the anode is the same as that desired in the deposit. If, under certain conditions of operation, the resulting deposit does not have the desired composition, correction is made by a suitable adjustment of the bath composition, the anode composition being maintained as indicated.

To provide optimum conductivity, the total metal (tin plus lead) content of the bath should be of the order of 85-110 grams per liter. Lower metal content results in deposits low in tin.

General Plating Conditions

The following conditions, which have been found suitable for plating a 90% lead-10% tin deposit, are typical for lead-tin alloy plating with alloy anodes.

Bath Composition	*g/l*	*oz/gal*
Total tin	10.0	1.34
Stannous tin	9.0	1.21
Lead	90.0	12.06
Free fluoboric acid	40.0	5.36
Free boric acid	25.0	3.35
Glue	0.5	.067

Operating Conditions

Temperature 70-100°F
Current cathode density 30 amp/sq.ft.

Anodes

Cast, 90% lead-10% tin
Ratio of anode to cathode areas 2:1

To make up a bath of the desired metal content, the calculated amounts of lead and tin concentrates are diluted with water in the ratio of 1 volume of concentrates to approximately 3 volumes of water. The boric and fluoboric acids are then added and the addition agent introduced.

Preparation of Alloy Anodes

The ratio of tin to lead and the distribution of the tin in the anodes are important. Table II indicates that the percentage of lead and tin in the alloy anodes should be the same as that desired in the deposit. Pure grades of tin and lead should be used. The anodes may be prepared by heating the lead-tin melt to about 400°C with constant stirring, followed by quick pouring and chilling. Anodes prepared in this manner exhibit a fine grain structure. Satisfactory alloy anodes are commercially obtainable.

Bath Make-Up and Operation

Free boric acid is added to the bath to prevent hydrolysis of the fluoborate radical and thereby to maintain stability of the bath. Approximately 25 g/l of boric acid has been found desirable.

Free fluoboric acid is maintained in the bath to keep the lead and tin in solution and thereby improve the stability of the bath, to combine with lead and tin as they dissolve from the anodes, to increase the conductivity, to give a fine-grained deposit, and to prevent treeing. Optimum conditions prevail at about 40 g/l of free acid.

Glue is added to the bath to promote the formation of adherent, fine-grained deposits. In the operation of the bath there is a certain amount of decomposition and loss of glue. More glue should be added as the appearance of the deposit indicates. A typical bath for 90% lead-10% tin would be started off at about 0.5 grams of glue per liter of solution. With lower tin concentrations it may be necessary to lower the glue content to about 0.4 g/l, while at higher tin contents the glue content should be raised to about 1 g/l for 25% tin and as much as 5 g/l for 60% tin. An animal bone glue is recommended.

The *stannous tin* content of the bath is one of the important factors in the successful operation of the lead-tin bath for deposits of low tin content. For example, in a freshly made bath containing 10 g/l of tin and 90 g/l lead, approximately 85% of the tin will be in the stannous state, the remainder being stannic tin. Such a bath will give a deposit containing 10% tin. However, if the stannous tin decreases and the stannic tin increases, the percentage of tin in the deposit will fall below 10. In other words, the lower the stannous tin contents, the lower will be the amount of tin plated out. In the baths containing much tin, for example 50 g/l tin and 35

g/l lead, stannous tin becomes less critical and there is less tendency for stannic tin to form in the bath. In the normal continuous operation of the bath, the stannous tin content remains quite constant, resulting in a deposit of a uniform tin content. If a long period of idleness is contemplated, it is advisable to filter the bath and to protect it from the air as much as possible to minimize formation of stannic tin.

A *temperature* range of 70-100°F has proven most satisfactory for the lead-tin fluoborate bath, the higher temperatures tending to increase slightly the percentage of tin in the deposit while the lower temperatures tend to decrease it.

A *cathode current density* of 30 amp/sq.ft. was found to be satisfactory for all bath compositions shown in Table I. Below 30 amp/sq.ft. there is a slight decrease in the percentage of tin in the deposit, while above 30 amp/sq.ft. there is no appreciable effect on the tin content.

Agitation is an important factor in insuring uniform deposits. Optimum conditions prevail when mild agitation is employed. The use of a still bath may result in a non-uniform deposit because of local exhaustion of the solution at the surface of the cathode. On the other hand, too vigorous an agitation of the bath results in an increase in the tin content of the deposit. Slow stirring or circulation through an outside pump provides the most suitable agitation. The use of a filter in the pump line will improve the deposit, particularly a heavy deposit, by removing suspended matter. Adequate agitation may sometimes be obtained by use of a moving work rod.

The *anode area* should be twice the cathode area.

A *current efficiency* of about 100% is attained at both anode and cathode in baths operating under the foregoing conditions. The tin and lead contents of the bath remain constant, as does the composition of the deposit.

PLATING OF BEARINGS

The plating of bearings is a special application which requires certain modifications. For example, a 2:1 ratio of anode area to cathode area is not possible, because the anode is placed inside the bearing and its size must necessarily depend on the inside diameter of the bearing. A cast cylindrical anode has proved most satisfactory. Experiments indicate that the diameter of the anode should be about one third of the diameter of the bearing, and that it should not be allowed to corrode to less than one sixth of the diameter of the bearing. The length of the anode should be no more than one inch greater than the length of the bearing. It should be stopped off with a lacquer or tape so that the exposed surface is slightly less than the length of the bearing. This prevents build-up of deposit on the rims of the bearing.

Another problem that arises in bearing plating is that of maintaining an adequate metal content in the electrolyte within the bearing. The bath is made up to have the composition recommended in Table II. The composition of the anode should also be the same as given therein. In general plating, this set of conditions would result in a deposit of the desired composition. However, in bearing plating, the relatively high ratio of cathode area to the volume of the enclosed electrolyte results in a rapid depletion of the metal content with a subsequent decrease of the percentage of tin in the deposit. The relatively small anode area necessitates rapid corrosion of the anode in order to replenish the metal content of the bath. Two measures have been found helpful in solving this problem: (1) mild circulation or agitation of the bath so as to maintain a flow of fresh electrolyte through the bearing, and (2) rotation of the anode which accelerates anode corrosion by preventing anode polarization. By maintaining suitable bath circulation, the composition of the electrolyte within the bearing remains more uniform and the tin content of the resulting deposit follows rather closely the tin content of the anode. The degree of bath agitation was found to be the most important factor in controlling the uniformity of the deposit. Anode rotation proved to be less important, but is nevertheless helpful.

Plating Conditions

Typical conditions, including the composition of the bath and operating conditions, established for plating a bearing with 92% lead-8% tin are as follows:

Bath Composition	*g/l*	*oz/gal*
Total tin	8.0	1.07
Stannous tin	7.0	.92
Lead	90.0	12.06
Free fluoboric acid	40.0	5.36
Free boric acid	25.0	3.35
Glue	0.5	.067

Operating Conditions

Current cathode density — 60 amp/sq.ft.
Temperature — 70-100° F
Agitation — Circulation of electrolyte, anode rotation optional

Anodes

Cast, quick chilled alloy anodes containing 8% tin and 92% lead

CONTROL OF BATH

The plating baths, for either of the methods described herein, are controlled by checking the total tin, stannous tin, stannic tin and the lead contents, and the acidity of the bath. Suitable analytical methods are described below.

The glue content is best controlled by small cell tests. A small sample of the

Applications for Lead-Tin Alloy

The lead-tin alloy deposits produced by the methods described are smooth, fine-grained, adherent and highly resistant to corrosion. They may be readily soldered. Because of these properties lead-tin alloy finds application as a coating for radio chassis, wire cable, electrical contact terminals and similar articles. Lead-tin alloy possesses lubricating properties, which, together with its resistance to corrosion, make it a desirable coating on bearings and automobile pistons. Another application utilizing the lubricating property is the plating of screws to render them non-seizing.

Figures 1, 2 and 3 show typical applications of lead-tin alloy coatings. It is significant that these alloys have been plated on cast iron, stainless steel and monel metal. Copper, brass and bronze are other common base metals that may be coated.

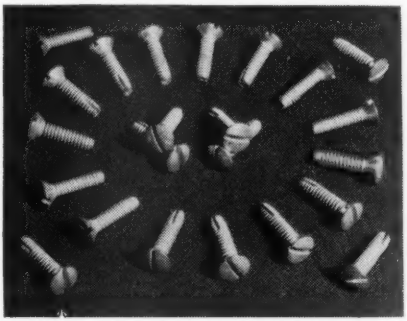

Figure 2. Stainless steel screws rendered non-seizing by means of a 40% lead-60% tin alloy coating.

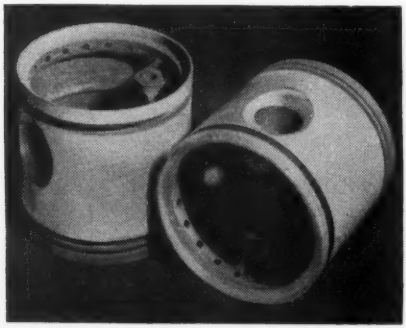

Figure 1. A cast iron automobile engine piston with a 90% lead-10% tin alloy coating.

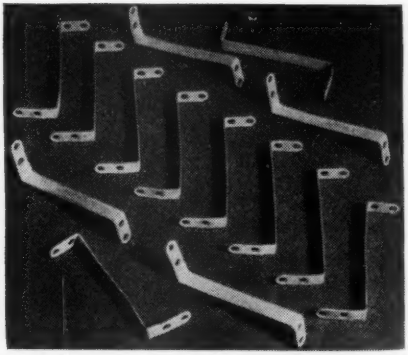

Figure 3. Monel strips coated with a 50% lead-50% tin alloy.

bath is electrolyzed with added amounts of glue until a satisfactory deposit is obtained. A proportionate amount of glue is then added to the plating bath.

Analytical Procedures

Total tin — A 5 cc sample of the plating bath is diluted with 100 cc of water in a 400 cc Erlenmeyer flask. Then 50 cc of concentrated hydrochloric acid, approximately 10 grams of iron ribbon and 1 gram of sodium bicarbonate are introduced into the solution. The solution is boiled gently for 10 minutes, the flask being equipped with an exit tube leading into a 1% solution of sodium bicarbonate. With the exit tube of the flask moved into a saturated solution of sodium bicarbonate, the solution is cooled rapidly. When it is cool, 1 gram of sodium bicarbonate and 5 cc of .1% starch solution are added. The solution is then titrated rapidly with 0.1 N iodine solution to the first ten-second end point.

cc 0.1 N iodine x 1.19 = g/l total tin

Stannous tin — A 5 cc sample of the plating bath is diluted with 100 cc of water in a 400 cc Erlenmeyer flask. Then 50 cc of concentrated hydrochloric acid, 5 cc of 0.1% starch solution and 1 gram of sodium bicarbonate are added to the solution and the solution titrated rapidly, in the cold, with a 0.1 N iodine solution to the first ten-second end point.

cc 0.1 N iodine x 1.19 = g/l stannous tin

Stannic tin —

g/l total tin — g/l stannous tin = g/l stannic tin

Lead — A 5 cc sample of the plating bath is introduced into a 400 cc beaker containing 200 cc of 10% sulfuric acid. The solution is boiled gently for 10 minutes and then cooled. After the precipitate has settled, the solution is filtered through a tared Gooch crucible and the precipitate washed twice with 1% sulfuric acid. The Gooch crucible is dried, placed in a porcelain crucible and heated over a flame for 10 minutes, cooled and weighed.

gram $PbSO_4$ x 136.6 = g/l lead

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The Reader's Corner

Adhesion of Electrodeposits

Sirs:

NEW applications of plating for reasons other than decoration and corrosion protection have emphasized the importance of adhesion. This word, as it applies to electrodeposited metal coatings, should be clearly defined so that it relates to a specific condition. A useful distinction between *adhesion* and *bond strength* is proposed herein, supported by photomicrographs.

Reference is made to the recent series of articles in the MONTHLY REVIEW on "The Adhesion of Electrodeposits" by A. L. Ferguson and E. F. Stephan, published in connection with A.E.S. Research Project No. 3. This work has very ably presented material on the subject and clearly points out that adhesion has been loosely defined and discussed in many quarters. The authors clearly focus attention on the many factors that have to be considered when adhesion is evaluated. They find there is no exclusive measure for good adhesion.

The perfection of adhesion of electrodeposited coatings is related not only to the metals involved, their physical properties and cleanliness for plating, but also to the use of the plated part.

It is apparent from the Ferguson-Stephan survey that adhesion is either satisfactory for a given function or it is unsatisfactory. A quality test should, therefore, relate to the actual service of the plated parts, and should not be based solely upon some academic and unrelated numerical value or laboratory test.

The case is summed up on page 1012 of the October 1945 issue:

"This statement indicates that Blum would qualify *perfect adhesion* according to the particular use to which the deposit will be subjected in actual service.

"Later in his discussion, Blum makes another highly significant statement concerning his interpretation of the expression *perfect adhesion:*

" 'On page 11, reference is made to the effect of an intermediate film of a weak metal. A striking example was found in plating nickel over a thin layer of zinc or cadmium on steel. The nickel coating could be easily pulled, leaving a film of zinc or cadmium on both the steel and the nickel. In such a case, *there is perfect adhesion, though the apparent adhesion is poor.* In fact, it might be considered that, whenever fracture occurs in a base metal or undercoat the adhesion of the outer coating is *perfect by definition.*' " (Italics mine).

To this statement should be added the comment that adhesion is also perfect by definition if the fracture occurs entirely in the plated metal of major interest.

There should be ready agreement that adhesion is best defined in terms of the conditions of the test relative to the service requirement. Hence it would be well to consider distinguishing between adhesion and *bond strength* as follows:

Bond strength would be measured by the force required to separate the plate from the basis metal regardless of the place of fracture and would be distinguished from *adhesive strength* which would be measured by the force required to separate the plate at the interface between itself and the base metal surface. As thus defined, the adhesive strength may exceed the bond strength, but the latter could never be greater than the former.

It is recognized that this is an arbitrary distinction, but adoption of the two terms would clarify the condition in reference when either term is used. Some justification for making this distinction is shown by the following photomicrographs of Ollard test specimens. These were made to evaluate the surface condition of steel in terms of the tensile strength of the adhesion of nickel plate to the steel.

Fig. 1 shows the two halves of an Ollard test specimen for which fracture occurred at the interface between nickel plate and machined SAE 1010 steel. The nickel plate as shown subsequently, had a tensile strength of 90,000 psi and the steel, 100,000 psi, yet the plate separated from the steel at 25,000 psi. The machining lines in the steel are reproduced in the nickel surface detached from the steel. Before plating, the

steel was vapor degreased and put directly in a Watts nickel bath. The steel was not "clean", and hence the Ollard test shows *poor adhesion* according to the proposed terminology.

The four figures used in this discussion show at a magnification of 20X top and bottom parts of test samples such as that found in Fig. 43, page 63, of the January issue of the MONTHLY REVIEW. The "fracture surface" referred to on the photomicrographs herein, is at the zone marked "interface" in Fig. 42 on page 63 of the January issue. The machining lines that are visible on the portion marked "nickel plate" in Figs. 1 through 4 of the present discussion, are visible because, in photographing at 20X magnification, the nickel surface was only 0.01 in. below the plane of focus on the fracture surface. On the other

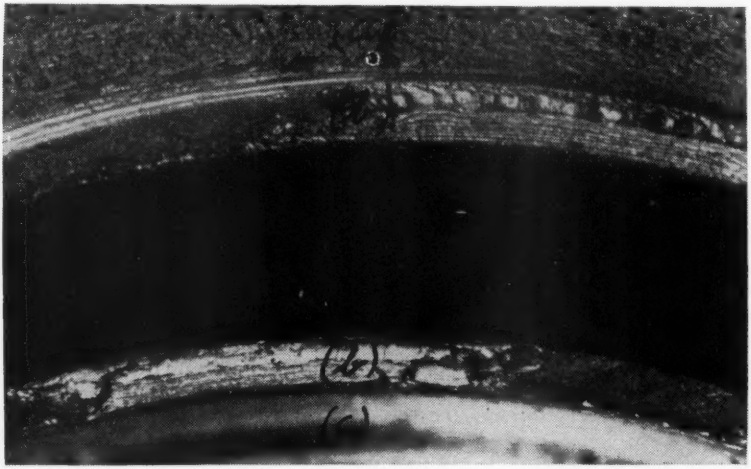

Fig. 1. Clean fracture at 25,000 psi between nickel plate and improperly cleaned machined SAE 1010 steel. Poor adhesion. (a) Nickel plate, (b) fracture surface, (c) steel. X20, reduced to X13.

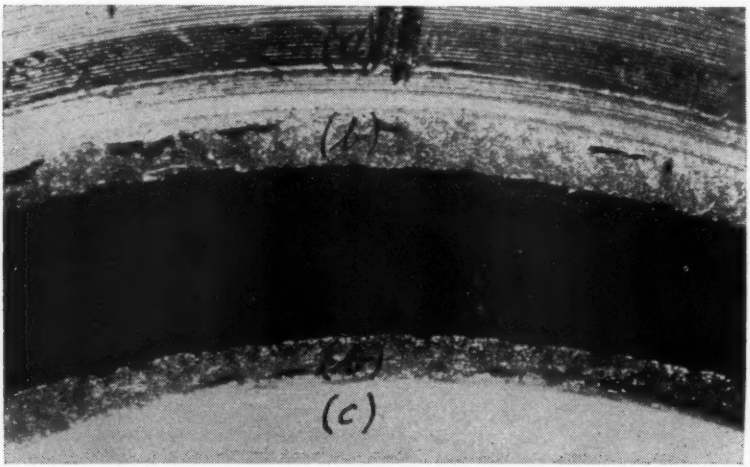

Fig. 2. Fracture at 35,000 psi in brittle, machined SAE 1010 steel layer adhering to nickel plate because of proper cleaning. Perfect adhesion but poor bond strength. (a) Nickel plate, (b) fracture surface, (c) steel. X20, reduced to X13.

hand, the steel "half" was 0.125 in. below the fracture surface and, therefore, completely out of focus.

Fig. 2 shows another Ollard specimen in which the steel had been subjected to the customary cleaning by direct and reverse current in an alkaline cleaner, rinsing, dipping in 10 per cent hydrochloric acid, and rinsing just prior to plating in the Watts nickel bath. The two portions of the Ollard specimens, which broke at 35,000 psi clearly reveal a brittle fracture in the steel surface layer. The nickel plate is completely covered with steel from the brittle fracture. This is an example of *perfect adhesion*, but *low bond strength*. The surface layer of

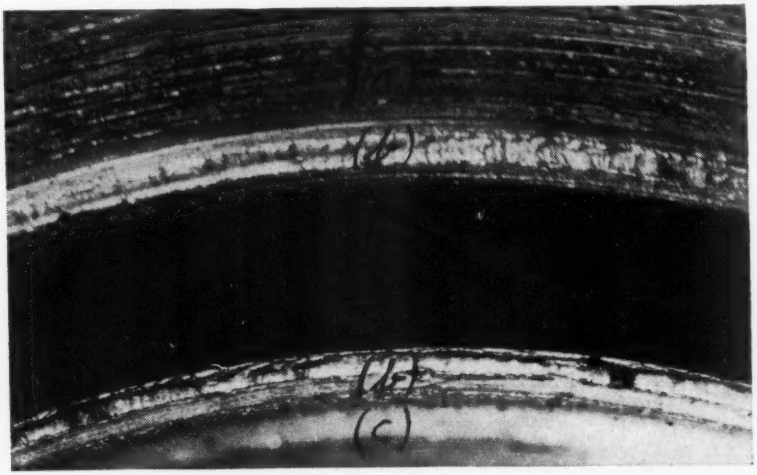

Fig. 3. Fracture at 60,000 psi both in ductile nickel plate and in brittle, machined, incompletely polished SAE 1010 steel, properly cleaned before plating. Perfect adhesion but less than maximum bond strength. (a) Nickel plate, (b) fracture surface, (c) steel. X20, reduced to X13.

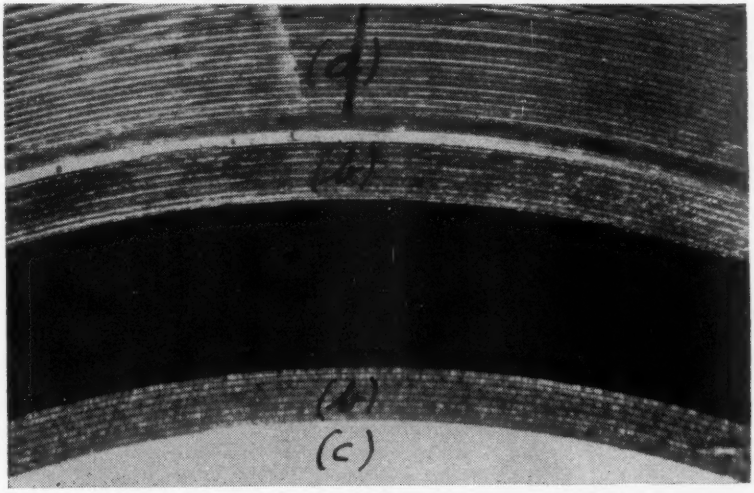

Fig. 4. Ductile fracture at 90,000 psi entirely in nickel plate. Brittle machined layer of SAE 1010 steel base completely removed by polishing prior to proper cleaning. Perfect adhesion, maximum bond strength. (a) Nickel plate, (b) fracture surface, (c) steel. X20, reduced to X13.

the steel was weaker than the base metal should be and weaker than the nickel plate.

Another Ollard steel test specimen was machined in the same manner as those in Fig. 1 and 2, then lightly polished by hand with No. 1 emery paper to remove part, but not all of the tool marks. It was cleaned and plated as the specimen in Fig. 2. Fig. 3 shows the fracture that occurred at 60,000 psi. Some brittle-fracture steel is seen on the nickel-plate portion and some nickel plate adheres to the steel. This specimen again shows *perfect adhesion, but not maximum bond strength.* Portions of the steel surface layer were stronger than the nickel plate and other portions were weaker.

Fig. 4 shows the two parts of an Ollard specimen which was prepared like that in Fig. 3, except that all of the machine-tool marks were removed by light hand polishing on No. 1 emery paper. The specimen broke at 90,000 psi entirely in the nickel plate with a characteristic ductile fracture. Thus, *perfect adhesion* and *maximum bond strength* were both achieved.

It can be interpreted from these tests that *there can be only perfect or poor adhesion,* but that *different degrees of bond strength are possible.* What degree will be required is determined by service needs. Obviously, there is only one maximum bond strength value for any given pair of base and plated metals. That maximum is the tensile strength of the weaker of the two metals in question. Thus, for the particular Watts nickel plate used throughout the the cited tests, 90,000 psi was the maximum attainable bond strength. For the same steel with annealed silver plate, 25,000 to 30,000 psi would be the maximum bond strength, because that is the tensile strength of the silver. It is quite apparent that the steel need not be finished to the same degree of freedom from weak, damaged surface metal for heavy silver plating as for heavy nickel plating.

Tensile strength has been used in this discussion, but shear strength, etc., of the component parts bears the same relationship to adhesive strength and bond strength.

The most important part of any consideration of adhesion of electrodeposits is the clear understanding and evaluation of each particular situation.

The factors involved in adhesion are aptly presented by Ferguson and Stephan, particularly on page 1012, October 1945 issue, first paragraph, under the title "The Highest Type of Bond Between Deposited and Base Metals". Their discussion should be studied by all who are interested in the topic.

The selective use of the terms adhesion and bond strength makes it possible to state the numerical limits which everyone is seeking. Note the quotation from my talks on electropolishing, upper left column page 1019, October 1945, MONTHLY REVIEW. In the two instances where the words "bond strength" are used, the word "adhesion" should be employed instead.

The data in Table II, page 1020, October 1945 issue (quoted from Hothersall's paper) are interesting to interpret in terms of adhesion and bond strength. Buffing is well known to "work" the surface of metals and to "break down" the crystals therein to a very fine disarrangement. The amount of "damage" and "surface weakening" is related to the amount of mechanical working. The photomicrographs of Figs. 1 through 4 demonstrate that the *Ollard "adhesion" test measures bond strength* and shows about 35,000 psi for the latter, when nickel is deposited on surface-damaged, but otherwise clean steel. Hence, it appears that Hothersall's values of 37,000 to 40,000 psi for mild steel, 45,000 to 48,000 for 0.5 per cent carbon steel, and 35,000 to 43,000 for 0.1 per cent carbon steel, are not measures of adhesion, but of bond strength, which, in those cases, is the strength of the "damaged" metal layer.

There will probably never be a single practical test for adhesion. Adhesion should be considered as solely a matter of workmanship in plating, and like that, is either good or bad. Adhesion of a degree should not be accepted. If adhesion is not perfect, the preparation and plating process either are not under proper control or are improperly selected for the job.

Bond strength can only be expressed as being greater than some numerical value which is the expression of strength of the weaker of the two metals: basis metal and plated metal. There is no reason to expect more than this. There are rare cases where the interface, because of metallic diffusion is mechanically weaker than either the basis metal or plated metal. Even so,

(*Continued on page* 326)

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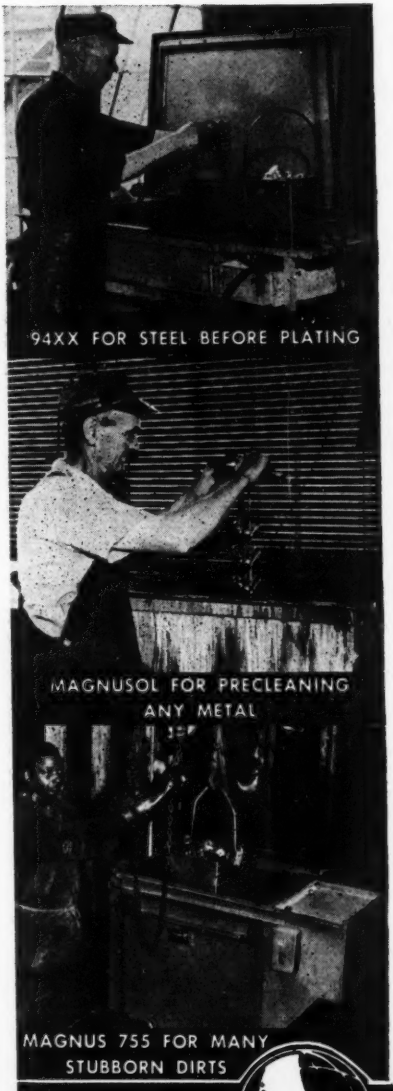

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ELECTROPLATING UPON ALUMINUM

By WALTER R. MEYER, Ph.D.

President

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This paper was presented at the Annual Educational Session of the Detroit Branch of the American Electroplaters' Society held on December 8, 1945.

APPLICATIONS

BECAUSE of the lightness, availability and low cost of aluminum, there has been a considerable demand for electroplated coatings upon aluminum and its alloys. Silver plating to lower electrical contact resistance is an important example.

Aluminum is sometimes plated as part of an assembly containing other metals such as steel or copper. In such cases the assembly is normally cadmium, zinc or nickel plated.

Aluminum is copper, tin or nickel plated when it is to be soldered. If the copper coating is too thin (less than 0.0001"), there is danger of poor bonding because of complete alloying between the molten tin in the solder and the copper. There is less danger of dissolving a nickel coating, particularly when soldering is done by immersion in the molten solder.

If bonding of rubber to aluminum is required, the aluminum is brass plated in the solutions usually used for this purpose.

Coloring of aluminum is sometimes done by first copper or brass plating and then oxidizing the plate. However, there is danger in this procedure when the coating is porous, because many oxidizing solutions are alkaline and tend to attack the aluminum through the pores of the coating.

During the war heavy coatings of chromium plate were applied to aluminum, particularly airplane engine cylinders, to provide resistance to chemical attack and wear. In such cases, the chromium is usually applied over thin copper or copper-nickel coatings.

The chief use of plated aluminum is for decoration. Nickel and chromium, gold, silver and other metals are applied to articles to be carried, such as cigarette lighters, dress ornaments and bracelets, which are made of aluminum because of its lightness.

METHODS OF PLATING ALUMINUM

Electroplating of aluminum has been studied for the past thirty years, and many methods have been patented over this period. However, generally satisfactory plating of aluminum has been produced only during the past five years largely because of the development of two methods. One method consists of electrochemical oxidation and plating upon the oxide or partially reduced oxide film. The other method involves the use of a modified sodium zincate dip. The procedures which make use of electrochemical oxidation have been described by others[1] and will not be discussed at this time.

Almost all processes for electroplating upon aluminum involve chemical replacement with another metal or metals or oxide formation. A possible exception is direct plating of light and heavy chromium coatings. One notable application is chromium plated aluminum ironer shoes[2] on which the plate must withstand considerable wear as well as temperature changes.

The modified zincate method to be discussed involves the following steps:

1. Pre-clean if the work is buffed.
2. Alkaline clean.
3. Remove smut.
4. Immerse in the modified zincate solution.
5. Plate.

Suitable rinses follow all operations.

This method has given adhesive forces between the plated coating and the aluminum as high as or higher than the rupture strength of the aluminum base metal. Bonding strengths from 15,000 to 50,000 psi have been reported.[3]

There is no embrittling effect from heating of the plated aluminum. Diffusion and blistering, such as is experienced with copper plated zinc base die castings, seldom occur as the result of heating in the temperature range 200 to 400°F.

PREPARATORY STEPS

Buffing of Aluminum

If high gloss coatings are desired on aluminum, it should be buffed to a high luster. It is not necessary, however, to provide the extremely high luster obtained with the use of lime compounds. Aluminum is very susceptible to smoothening by means of wire brushing, abrasive buffing or scratch brushing. Fine wire brushing, which obviates the difficulty attendant upon the removal of grease buffing compositions, can frequently be used. Heavy copper or nickel coatings can be buffed to a high luster.

Thin gauge aluminum easily collapses during the buffing and brushing operations, and the use of special forms to hold the aluminum is often necessary.

The aluminum surface need not be roughened mechanically to secure high adhesion of the plated coatings as was formerly thought. In fact, tests indicate that severely roughened surfaces tend to give poorer adhesion than smooth surfaces.

Pre-Cleaning

It is just as necessary to clean aluminum properly as other metals for electroplating. Many failures of plated coatings have been caused by improper cleaning. Work that has been buffed with grease compositions should be pre-cleaned by means of emulsion cleaners or vapor-solvent degreasers. Simple vapor degreasers tend to leave a film of solid dirt that results in rough coatings. Emulsion cleaners containing naphthas or straight chain hydrocarbons are frequently too poor solvents to penetrate grease films. Those containing chlorinated compounds such as ethylene dichloride are more effective.

After soaking in the emulsion cleaner, the work should be rinsed thoroughly with two running cold water rinses or by means of a pressure spray rinse. The latter type is preferred. If emulsion pre-cleaning or vapor-solvent degreasing is not used, the work must be immersed in the alkali cleaner so long to remove the packed-in solid dirt, that a very rough base will result. This makes it extremely difficult to secure a highly buffed plate.

Racking

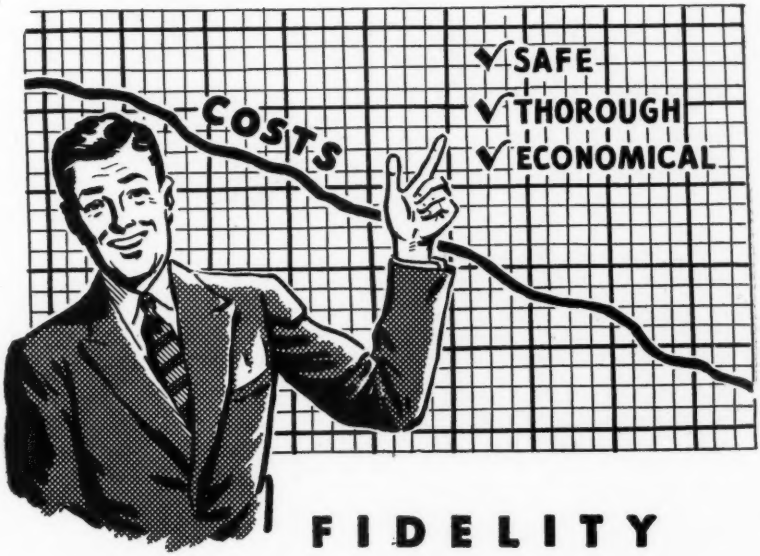
At first thought racking of aluminum objects appears easy. However, because of the lightness of most objects, loose racking does not permit sufficient pressure of the work against the hook to provide a secure contact either between the work and work hook or where the hook contacts the bus bar. As a result, thin or imperfect plating may occur. *It is important that tight racking of aluminum be employed to secure good results.* Spring contacts should be used for racking the piece, and the aluminum rack itself should be clamped to or fitted snugly against the bus rod. Many cases of defective work have been noted where the work is simply placed on hooks. A portion of the parts may be satisfactory while another portion may be defective even though all have gone through the same operations. The difficulty results from poor contact in racking. The racks should be made of springy aluminum wire such as 17S.

Almost all plated coatings can be stripped from aluminum wire in a 50 per cent by volume solution of nitric acid without harming the aluminum. Racks are frequently made of bronze, brass, or copper. However, there is danger of an electrochemical action taking place during immersion in the zincate solution which will prevent proper formation of a zinc film especially adjacent to the point of racking. If the rack contacts the piece inside where the plating will not show, racks made of metals other than aluminum may be satisfactory. However, even in such cases, the body of the rack should be coated.

Alkaline Cleaning

All alkaline cleaners are not suitable for cleaning aluminum previous to plating. Some cleaners containing silicates leave an adsorbed film upon the surface that definitely interferes with proper plating. Alkalis such as sodium hydroxide, trisodium phosphate, tetrasodium pyrophosphate and sodium carbonate in various combinations are satisfactory. Good cleaners especially compounded for preparing aluminum for electroplating contain surface active materials that increase detergency and create foam to reduce the hydrogen-caustic spray. These materials, however, must be selected so that they do not precipitate as calcium, magnesium or aluminum salts and must not be easily salted out. The normal cleaning time in properly compounded cleaners is from 10 seconds to one minute. The shorter

TESTS PROVE...



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time can be used when pre-cleaning is done. The operating temperature range is from 170 to 190°F. At higher temperatures, there is too violent a reaction between the cleaner and the aluminum. After cleaning, the work should be thoroughly rinsed in running cold water or by means of a pressure spray rinse.

Smut Removal

There is always some smut formed upon the aluminum surface in the alkali cleaning operation because of preferential solution of the aluminum. This smut can be one or all of the following metals: iron, copper, silicon, manganese, or nickel. There may also be some magnesium hydroxide. All of the metals with the exception of silicon can be removed by immersion in a strong nitric solution at room temperature. The following acid dip is recommended:

Nitric acid, conc., 36° Baumé — 2 gallons
Water — 1 gallon

The dip should be kept in a chemical stoneware vat or crock and maintained at room temperature. The dipping time is from 10 to 30 seconds. Long immersions in this acid solution of the order of several minutes may passivate the surface sufficiently to prevent a uniform film from depositing in the zincate solution. Lesser concentrations of acid can be used, as low as one volume of acid and one volume of water being satisfactory. However, it is suggested that the stronger solution be used to permit drag-in of water until a 50% by volume mixture is obtained.

When alloys containing copper are dipped in this solution there will be a gradual build-up of copper. The copper concentration may become so high that it precipitates on high purity aluminum or on magnesium-containing alloys. Thus, if high purity aluminum and copper-containing aluminum alloys are being treated at the same time and the copper concentration is high in the acid solution, there may be difficulty due to replacement of copper upon the high purity aluminum alloy. To determine whether the copper concentration is too high, one need merely immerse a clean sheet of high purity aluminum in the acid. If no copper film is noted after several minutes' immersion, the copper content is low enough for satisfactory performance.

The following solution potentials (measured against the normal calomel electrode) in air-saturated 2% sodium chloride solution at 20°C were determined by Zeerleder:

Aluminum, 99.3% — -0.750 volt
Aluminum of type Al-Mg-Cu — -0.60 volt
Aluminum of type Al-Mg — -0.850 volt

It is interesting to note that the zinc potential measured under the same conditions has a value of -1.050 volt. Zinc, therefore, will protect aluminum electrochemically when exposed to strongly corrosive and conductive solutions or atmospheres.

A simple method for determining whether all smut has been removed or not is to rinse the part thoroughly after the nitric acid dip, make a cross with the finger on the surface, and allow it to dry. If the cross can not be seen after drying, smut removal was complete. Certain alloys may contain small amounts of silicon which can only be detected by this method.

Alloys containing silicon must be bright dipped in a bath similar to the following:

Nitric acid, conc., 36° Baumé — 3 volumes
Hydrofluoric acid, 48-52% — 1 volume

The dip should be kept at room temperature.

This dip is used mostly for the cast aluminum alloys and is required in order to secure good coatings on alloys containing silicon. *Hydrofluoric acid is a dangerous acid physiologically and should not be permitted to come in contact with the skin.* Good exhaust ventilation should be provided.

Selection of a container presents a problem because almost all metals as well as ceramic ware are attacked by the solution. Rubber is unsuitable and decomposes rapidly. Vinyl-type coatings are not attacked as rapidly but gradually decompose. Containers made of specially treated graphitic carbon or wax-coated lead are recommended. Polyethylene withstands this acid mixture. However, there has been difficulty in joining polyethylene sheets to make satisfactory tanks. There is some indication, however, that the material can be sprayed upon the walls of tanks to make a satisfactory coating. If a metal tank is to be wax coated, it should be made of stainless steel which is much more slowly attacked than is plain steel.

Modified Zincate Solutions

The success of this process has been due

to the use of very concentrated sodium zincate solutions containing a considerable excess of sodium hydroxide to repress zinc ion formation.

Satisfactory solutions have zinc contents ranging from 8 to 10 oz/gal and sodium hydroxide contents of from 40 to 60 oz/gal.

One process used commercially employs copper in the form of a complex ion.[4]

The zincate solution is used at room temperature, preferably between 70 and 80°F. Its concentration can usually be controlled by means of density measurements.

The work to be treated should be agitated when it first enters the zincate solution to displace the water film. The length of time in the solution depends upon the alloy and must be determined empirically. It varies from 10 seconds for pure aluminum alloys to one or more minutes for copper-containing alloys. Silicon-containing cast aluminum alloys are usually given a relatively short treatment of 5 to 10 seconds.

The aluminum should not come into electrical contact or be in an electric circuit with the steel tank because under such conditions it will become anodic to the steel and a satisfactory zinc film will not be formed. Steel or stainless steel tanks are more suitable than tanks of ceramic ware since there is danger of cracking of ceramic ware because of the heat of formation of sodium zincate and the heat evolved on solution of the sodium hydroxide.

The zinc film should be uniformly gray. A spotty appearance indicates that the pretreatment is not satisfactory.

PLATING UPON THE ZINC FILM

The following metals have been plated satisfactorily upon the zinc film: silver, copper, brass, nickel and cadmium.

The ideal pH range for plating upon the film is from 6 to 10. Solutions that are highly alkaline such as the cyanide-zinc solution or sodium stannate tin solution can not be used for plating upon the zinc film.

Silver Plating

Silver plating can be done very satisfactorily directly upon the zinc film. The work should be first struck in the usual strike solution containing approximately 0.3 oz/gal of silver cyanide and 12 oz/gal of potassium cyanide; operating temperature, 70-80°F; current density, 10-40 asf; time, 30 seconds to 2 minutes. It is then plated in the usual silver plating bath.

Copper Plating

Cyanide copper plating solutions can be used. However, it is recommended that the free cyanide be maintained below 0.4 oz/gal, and that the pH be not higher than 10.5. The initial current density can be from 10 to 30 asf for the first minute and should then be adjusted to the normal operating current density of the copper solution used. There is a tendency for the pH of the solution to rise gradually due to drag-in of the zincate solution. It can be lowered by the addition of a dilute solution of tartaric acid. The optimum temperature range is from 80 to 90°F.

High pH, high free cyanide and high operating temperature all contribute to blistering of the deposited copper.

One very successful bath for depositing copper upon the zinc film is the copper pyrophosphate plating solution.[5] The pH of this solution, 7.2-7.5, is only slightly on the alkaline side and, therefore, no difficulty is experienced with high pH. The operating temperature ranges from 110 to 140°F, and current densities from 10 to 40 asf are used. *Solutions of this type should be air agitated.* The deposits obtained are relatively bright and permit reasonably bright subsequent nickel plated coatings to be deposited. The solution also appears to have good throwing power.

Fluoborate solutions have not as yet been investigated for plating upon the zinc film.

Nickel Plating

It is possible to nickel plate directly upon the zinc film using ammoniacal nickel solutions[6] which have good throwing power. Their chief drawbacks are relatively low limiting current density and tendency for the deposits to be somewhat hard.

Nickel from standard solutions is usually deposited upon a copper plate applied in either the cyanide type copper solution or the pyrophosphate type solution. The copper undercoat should be approximately 0.0001 in. thick if it is not buffed.

There have been occasional cases of severe pitting of nickel deposited from a Watts type solution upon a thin copper plate, probably due to the physical contour

in acrobatics it's balance

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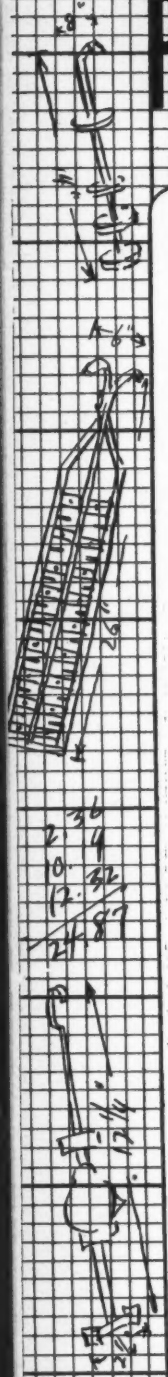

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2. **Will the design give proper metal distribution so specified minimum weight of plate is obtained without over-plating of exposed areas?**
3. **Will cross-sections of current carrying members be adequate for (a) proper current distribution? (b) preventing local over-heating that promotes rapid failure of coatings?**
4. **Will current shields and intermediary or auxiliary anode features be *properly* provided *when* necessary?**
5. **Because copper has five times greater conductivity, will its use be maximum and brass minimum?**
6. **Will templates be used in drilling to insure perfect construction and tight joints?**
7. **Will segments be riveted for strength and cleaned before joining so current-robbing oxides cannot form, then silver or soft soldered for highest conductivity?**
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of the finely etched surface. Wetting agents and hydrogen peroxide in the nickel solution do not completely overcome this pitting difficulty, and some of the poor corrosion tests obtained with nickel plated aluminum may have been due to fine pitting. This pitting can be overcome by applying a heavy copper coating of the order of 0.0003 in. or more, buffing the copper coating and then nickel plating upon the buffed copper. This is an excellent method for preparing aluminum for bright nickel plating.

Chromium Plating

Some cases have been reported of direct chromium plating upon the zinc film with results not entirely satisfactory. It is recommended that chromium plating be applied after copper or nickel plating.

Brass Plating

Brass can be plated successfully without a copper undercoat. The pH of the solution should be kept below 10.5 and, in general, the same precautions are taken as with copper cyanide plating solutions.

Cadmium Plating

Cadmium can be plated upon the zinc film. However, in most cases, a cadmium strike solution must be used containing about 2 oz/gal of cadmium and 8 oz/gal of total sodium cyanide. Following about one minute plating in this solution, work can be transferred to a standard bath.

References

[1] Wm. J. Travers, U. S. Patent No. 1,971,761, Aug. 28, 1934.

[2] Wm. H. Bowden, U. S. Patent No. 1,988,645, Jan. 22, 1935.

[3] H. Bengston, Trans. Electrochem. Soc. 88 (1945); Private communication, A. W. Hothersall.

[4] "Alumon" Process, Enthone Co., New Haven, Conn., U. S. Patent No. 2,142,564.

[5] A satisfactory process is sold by United Chromium, Inc., New York, N. Y.

[6] A satisfactory ammoniacal solution is marketed by Zialite Corp., Worcester, Mass.

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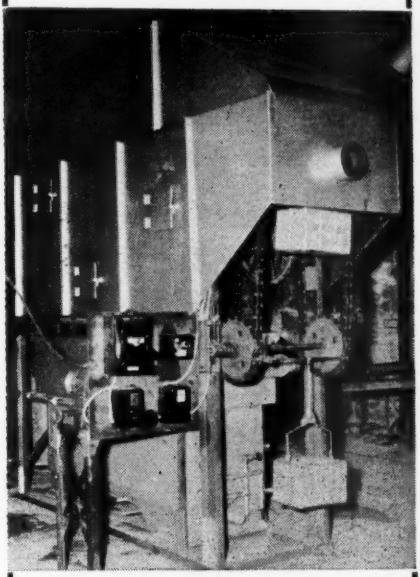

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THE ADHESION OF ELECTRODEPOSITS

IV. CORRELATED ABSTRACT OF COMMENTS ON METHODS FOR MEASURING THE DEGREE OF ADHESION

A. E. S. Research Project No. 3

Project Director: A. L. Ferguson

Chemistry Department, University of Michigan
Ann Arbor, Michigan

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(Continued from February Issue)

The Grinding Wheel Test

FROM the private communications, it is evident that this is one of the most commonly used qualitative tests. It is generally considered about the most drastic test in existence and will show lack of satisfactory adhesion when other tests fail. The procedure used by C. F. Nixon is typical:

"Use has been made of a grinding wheel test in which a plated part is held against a high speed coarse wheel in such a fashion that the cut is made from an edge and enters at a slight angle. The effect is to give a series of lifting impacts to the plate. If no part of the plate (usually nickel in this case) lifts from the base metal, the adhesion is declared satisfactory.

"A variant of the grinding test was applied when worn parts plated back to dimension were ground to finish size. While the procedure was not applied primarily as an adhesion test, it very definitely indicated that the method of surface preparation was satisfactory. In many cases portions of the plate were entirely ground away without plate separation."

R. B. Saltonstall, Technical Director of The Udylite Corporation, made some interesting comments on the method:

"There is a knack to using this test which makes it difficult to describe. It is acquired only after some experience and the test is far from quantitative. The ductility of the deposit is a rather important factor in evaluating the results. If the deposit is extremely brittle, it will simply break off at the point of contact with the grinding wheel rather than pull away from the base metal."

The Cathodic or Electrolytic Test

Cathodic treatment in which hydrogen is liberated at high current densities was mentioned by a few correspondents. A very thorough investigation of the possibilities of such a method was reported by A. W. Hothersall:

"The possibility of using this method to demonstrate poor adhesion of nickel coatings on other metals has been explored. As a preliminary step, the effect of conditions (composition of solution, current density, temperature and properties of nickel deposit) on the rate of expansion of nickel was examined, since it was uncertain to what extent blistering or peeling was assisted by expansion of the deposit or by pressure of gaseous hydrogen. Considerable differences in the rate of expansion were found with different conditions of cathodic treatment and with different types of nickel deposit, but little difference in the effect of these conditions on the blistering of poorly adherent nickel coatings on brass could be detected.

"In subsequent tests, a solution of sulphuric acid (5% by weight) was used. The efficacy of the test was examined by the use of two sets of nickel plated specimens with strongly and weakly adherent coatings, respectively. No blisters were produced on the strongly adherent coatings even after cathodic treatment in the sulphuric acid solution for several hours. All poorly adherent coatings showed blisters after cathodic treatment in the sulphuric acid bath. The number and size of the blisters increased with the time of treatment. They were found to develop more quickly at high current densities and at a high temperature of the sulphuric acid solution. After some experimenting, it was found that the most suitable conditions for general use were: current density 100 amp. per sq. ft., solution temperature 60°C. Weakly adherent nickel or nickel-chromium coatings on brass or steel were found to develop blisters in 5-15 minutes under these conditions. In general, after the electrolysis had been stopped, the specimen would produce a crackling noise for some considerable time, whilst immediately after treatment quantities of gas could be seen spurting from the deposit through the film of liquid on the surface. It appeared probable as a result of these tests that the blistering was chiefly caused by the pressure of gaseous hydrogen which diffused through the nickel coating and accumulated at the site of discontinuities between the coating and the base, forcing the coating away from the base. Examples of the appearance of nickel and nickel-chromium coatings on brass after testing by this method are shown in Figs. 11 and 12 respectively (*our Figs. 7 and 8*).

Fig. 7. Nickel plate on brass after cathodic test.

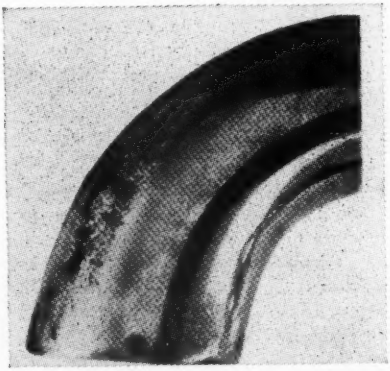

Fig. 8. Nickel-chromium plate on brass faucet outlet end after cathodic test.

"The electrolytic test is limited in application to coatings which are permeable to hydrogen. Nickel or nickel-chromium coatings appeared to react satisfactorily to the test if weakly adherent. This behaviour was independent of the conditions of nickel deposition. Coatings of metal such as lead, zinc, tin, copper or cadmium which are

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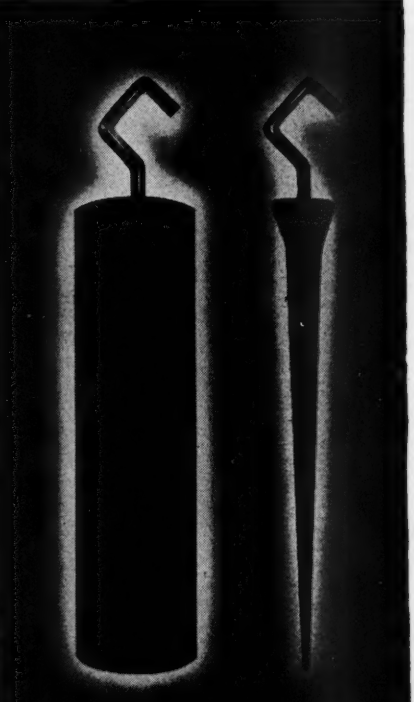

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not permeable to cathodically discharged hydrogen are not suitable for testing by this method. Similarly, nickel coatings deposited over an undercoating of a metal which is impermeable to hydrogen, for example copper, do not necessarily blister if weakly adherent. The test is thus limited in application and is not suitable for general purposes."

The X-Ray Test

This test was mentioned in only a few letters. A good brief statement concerning it is made by Vincent Mattacotti:

"X-Ray examination will show voids between the electrodeposits and the base metal. The usual X-Ray procedure of taking a picture and then interpreting the developed film is followed. Since many heavy electrodeposits are annealed after electroplating, spots characterized by poor adhesion tend to lift due to the pressure exerted by occluded matter. The blisters thus formed are either visible to the naked eye or can be made visible with X-Ray."

L. E. Weeg remarks:

"While I do not believe that the X-Ray method is satisfactory for general use, it does have real merit in special applications such as the silver plated bearing, in which the deposit is thick as compared to the thin deposits used in decorative plating, and for which a destructive test is prohibited. The most serious limitation is the necessity for X-Ray equipment which is not found in many laboratories."

The "Can Opener" Test

This is a rather new method and probably first developed by F. C. Mesle. In a recent communication Mesle states concerning this method:

"The 'can opener' with a spring coil is satisfactory for thin deposits, since enough pressure could be applied to lift or break .010 in. thickness of silver. For thicker deposits it was not satisfactory. A 'can opener' device can be used without spring coil and sufficient pressure applied to break almost any thickness of silver to determine if the adhesion is as strong as the tensile strength of the metal. The use of a tensile testing machine appears more satisfactory since it permits the bond strength to be expressed in psi. In bearings the bond must hold when enough pressure is applied to break the deposited metal. If plating is done for decorative purposes or for protection against corrosion of the base metal, such bond strength is not required but, in my opinion, still desirable."

The Jacquet Test

A method similar in some respects to the "can opener" test was developed earlier by P. A. Jacquet. It has not been mentioned except by A. Brenner. Work was carried out at the National Bureau of Standards on this method which was interrupted before completion and has never been published. However, some very interesting information was obtained, and since it has not been available heretofore and will not be published by the Bureau, a considerable portion of the above mentioned report is quoted here:

"The purpose of the research was to adapt Jacquet's peeling method to the quantitative measurement of the adhesion on specimens already plated, rather than to use it as a laboratory tool for investigating adhesion. We used a 600 pound Amsler testing machine to measure the force required to peel the coating from the base metal. At the time we intended to make parallel tests by the Ollard method in order to correlate the force required to peel a coating with the actual tensile strength as measured in the Ollard test, but the research was interrupted. We made a few tests by the Ollard method for demonstration only.

"One of the necessary mechanical requirements of the Jacquet test is that some method be devised to take hold of the coating to initiate the peeling. In a laboratory investigation of adhesion for which special specimens are prepared, a portion of the base metal can be treated to yield a separable deposit. For example, Jacquet dipped one end of the strip to be plated into a colloid solution, whereupon the subsequent copper deposit became non-adherent and permitted the peeling to be initiated. This method is not very satisfactory even for a laboratory investigation, because the colloid on the end might contaminate the rest of the strip on which good adhesion was desired; and, in certain preliminary treatments such as bright dipping, the

colloid would be removed from the end of the strip. A more satisfactory method is to plate the end of the steel strip with a weak or poorly adherent layer of gold or silver, which can later be peeled from the base metal along with the subsequent deposit. In some cases the final coating is not adherent to the gold and may be peeled from it. Another method is to prepare the end of the strip with a coating of nickel or other metal in such a manner as to make it poorly adherent to the base metal, and thus to permit peeling to be initiated after the final plating operation.

"These methods are not useful to initiate peeling on specimens which have already been plated. We have used the following methods for this purpose:

(1) "A piece of spring steel is ground to a sharp edge and bolted to the specimen as shown in the diagram (*our Fig. 9*). The edge of the steel piece is placed

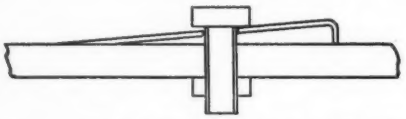

Fig. 9. Device for initiation of peeling on plated specimen for Jacquet test.

on the coating which is to be tested, and the coating is either removed in the vicinity of the edge or is scratched through. Then a thick layer of nickel 0.03 to 0.05 in. thick is plated over the whole specimen. The nickel coats over the steel attachment which then serves as a handle for starting the peeling of the original coating.

(2) "Another method of forming a grip to the original coating is to remove a portion of the original coating by machining or with emery paper. Then the entire specimen is coated with a thick layer of nickel. Since nickel coatings do not adhere very strongly to roughly machined or emeried surfaces, the peeling can be initiated at that point and continued for the purpose of peeling off the remainder of the coating. These methods presuppose that the subsequent nickel coating can be made to adhere strongly to the original coating. In practice, with suitable cleaning procedures, this can be done. However, if the adhesion of the original coating is very strong, then separation may occur between the first and second coating, in which case the measurement of the force required for the peeling would indicate that the adhesion was of a high order. By using these methods of peeling, the adhesion of coatings was measured on some of the panels prepared for one of the early A.E.S. programs.

"In the experimental work, nickel coatings deposited from a warm bath were used in thicknesses up to 0.05 in. The forces were measured in terms of kg per cm width, as usually a strip one centimeter wide was peeled. The force required for peeling varied from a few to about 200 kg per cm.

"Table I gives some representative values for nickel coatings on a few base metals.

TABLE I

ADHESION OF NICKEL COATINGS BY JACQUET METHOD

Base Metal	*Peeling Force kg/cm*
Cast iron	3
Malleable cast iron	25
Extruded brass	90
Cast brass	150
Nickel brass	150

"We have not been able to obtain a theoretical analysis of the forces involved in the peeling method, and hence have carried on the investigation empirically. It was found that both the force required to peel a coating and the amount of base metal removed in the peeling operation, increase with the thickness of the coating. This is true for coatings which have been prepared in the same manner and, therefore, should have the same degree of adhesion. The removal of base metal in this instance is to be distinguished from the variation in the amount of base metal removed from specimens which have unequal degrees of adhesion. In the latter case the amount of base metal torn out might vary from zero for a low degree of adhesion to a maximum figure.

"Table II gives examples of the effect of thickness on the detaching force and the amount of base metal removed.

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TABLE II

EFFECT OF NICKEL COATING THICKNESS ON PEELING FORCE AND BASE METAL REMOVED

Thickness inch	*Base Metal*	*Peeling Force kg/cm*	*Metal Removed g/cm²*
0.016	Cast Brass	100	0.018
0.031	" "	180	0.035
0.010	Copper	50	0.017
0.029	"	90	0.030
0.054	"	135	0.054
0.011	Extruded brass	32	0.006
0.035	" "	55	0.009
0.013	Malleable iron	15	—
0.025	" "	25	—

"The greater force required to peel thick coatings does not necessarily prove that the adhesion of the thick coating is greater than that of a thin coating. It is difficult to see how the thickness of a coating would affect its adhesion. The observed effect of thickness may be a result of the larger radius of bending of the coating where it makes contact with the base metal, thus exerting force over a larger area than with the thin coating. The larger amount of base metal removed with the thicker coating may be a result of the stress at the interface being proportionally larger in tensile than in shearing or tearing stress, which latter are more likely to occur when a thin coating is peeled.

"In order to determine definitely whether or not the effect of the thickness of coating was mechanical, or whether it actually represented increased adhesion, an experiment was performed in which two nickel coatings, one 0.03 in. and the other 0.08 in. thick were plated over 0.03 in. thick copper. An attempt to peel the copper from the nickel was not successful as the copper sheet tore.

"Since the adhesion between coating and base metal is not highly reproducible, experiments were made to test the effect of the thickness of the coating on the force required for peeling, by soldering copper strips of various thicknesses to a metal base. The adhesion obtained in this manner might be more reproducible than that obtained by plating, and might be independent of the thickness of the upper strip. The data in Table III show that an increased force is required to detach thick soldered strips. The detaching force seemed roughly proportional to the square root of the thickness of the strip. However K. G. Soderberg (unpublished communication) pointed out that a better proportionality was obtained with $T^{2/3}$ and that an inspection of Table II showed the same relation to hold for nickel deposits on cast and extruded brass, copper, and malleable

TABLE III

FORCE REQUIRED TO DETACH STRIPS OF COPPER SOLDERED TO STEEL

Thickness, T		$(Tcm)^{2/3}$	*Force, kg/cm Soldering Method*		*"Constant" $F/T^{2/3}$*	
cm	*inch*		*1*	*2*	*1*	*2*
0.013	0.005	0.055	5	7.5	90.4	136
0.041	0.016	0.119	9	12.5	75.6	105
0.079	0.031	0.184	16.1	26	87.5	141
0.127	0.050	0.253	—	35	—	138

TABLE IV

ADHESION OF NICKEL ON BRASS

Pretreatment	*Cast Brass*		*Extruded Brass*	
	Peeling Force kg/cm	*Base Metal Removed g/cm²*	*Peeling Force kg/cm*	*Base Metal Removed g/cm²*
Cathodic cleaning	150	0.035	55	0.009
Pumice scrub	33	0.001	18	0.001
Emery paper rubbing	5	0.001	23	0.001
Bright dip (HNO_3, etc.)	180	0.043	66	0.009

iron, for which the constants expressed in metric units are about 910, 540, 310, and 150 respectively. This empirical rule can be used to correct for the varying thickness of coatings used in the peeling tests, or the constant itself can be used as a measure of adhesion, as it is independent of the thickness of the coating.

"The effect of various pretreatments of brass base metals is shown in Table IV.

"In Table V some correlation is shown between the force required to peel a nickel coating and the results of qualitative adhesion tests which involve (1) bending the specimen back and forth until it breaks, and (2) use of a hammer and sharp chisel to initiate separation. The latter is a more severe test than the former when thick coatings are involved."

TABLE V

COMPARISON OF ADHESION TESTS FOR NICKEL ON STEEL

Thickness of nickel plated 0.003 inch

Peeling Force kg/cm	*Qualitative Test*
5	Separation on bending
18	Separation on bending or chiseling
55	Slight separation on bending; separation on chiseling
101	Slight separation on bending; separation on chiseling
150-180	No separation on chiseling or bending

The Explosion Test

In the communication from C. H. Greenall, Lt. Col., Ordnance Dept., Frankford Arsenal, mention was made of this recently suggested unique method:

"Recently this Arsenal had the pleasure of assisting Dr. A. Brenner, of the National Bureau of Standards, in a study of a method of measuring adhesion by exploding a primer charge in a groove cut through a nickel deposit. I am sure you will be able to obtain the details of this method upon request to Drs. Brenner or Blum."

The combined report of W. Blum and A. Brenner contained the following remarks on this method:

"Last year some experiments were begun in an attempt to use the force of an explosive to measure the degree of adhesion of coatings. In work done on the electroplating of gun bores, it was found that unless the adhesion was perfect, the coatings would be detached during firing. It therefore seemed as if a method could be worked out on the basis of this observation. Several preliminary trials were made at Frankford Arsenal, but we have had to postpone further studies until war work becomes less pressing.

"The specimens for the explosive test were prepared so as to have varying degrees of adhesion, particularly relatively low adhesion. These samples were prepared by plating the steel with a flash of nickel; immersing it in a very dilute solution of potassium dichromate, the concentration of which was varied to obtain different degrees of adhesion; rinsing, and returning it to the nickel plating bath. Cross lines penetrating the coating were then put on the specimen and a caliber 50 (0.5 inch) primer was exploded, either in contact with the specimen where the lines crossed, or slightly above the surface of the specimen. The primer was exploded by dropping

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a weight on it. In several instances, the primer caused the coatings having poor adhesion to peel in the region of the cross lines, but it did not consistently pick out all the specimens having poor adhesion. It is believed that the explosive force of the primer was not sufficient, because, if a 30 caliber primer was used, none of the samples peeled. In further experiments, we plan to use something in the nature of a dynamite cap, which can safely be set off by a battery. It explodes with a detonation, and should give sufficiently local gas pressure to disrupt the coating, while a caliber 50 primer does not produce a true detonation. It is advisable to try the most intense forces at first, and then by increasing the distance between the specimen and the explosive, or by diminishing the charge, to standardize the method. One difficulty is that the surface of the metal may become so blackened that it will be difficult to determine the condition of the coating."

The B. N. F. Impact Test

Another new method which has aroused considerable interest recently was developed by A. W. Hothersall, in England. A description of the method appeared in the May and June issues of Metal Finishing (*see also* MONTHLY REVIEW **32**, 1148 [1945]). Naturally not many comments have been received so far, as few people have had the opportunity to make tests. Those which have been received give the impression that the method is limited in its application to about the same extent as the burnishing method which it might replace. The following is from the combined report of W. Blum and A. Brenner:

"We have tried the vibrating hammer method recently developed by A. W. Hothersall, using both an electromagnetic and a mechanically driven vibrator. We were unable to blister a coating unless the adhesion was so poor that the coating was readily peeled with the fingers. Therefore the method does not seem suitable for testing commercial products which have any appreciable degree of adhesion. The vibrator did not blister coatings which had failed in service by peeling."

Hothersall refers to this method as the "B. N. F. Adhesion Test". In a recent letter he has the following to say:

"The work that we have done on this subject, described in Jl. Electrodepos. Tech. Soc., **19**, 49 (1944), resulted in the development of an apparatus which is designed to select non-adherent coatings. The problem becomes complicated as soon as the coating has some adhesion to the base, and we have not succeeded in finding any universal test. Though it is admittedly of limited value, it is likely to fulfil a useful purpose, because we have been able to pick out with this tester quite a few commercially plated articles which appeared satisfactory but whose coatings had no adhesion. The tester probably does no more than a skilled man can do with a burnishing or scraping tool but it has the merit of being a standard apparatus designed to produce the same result when operated by different people. This method has been adopted in the British Standard Specification, 1945, No. 1224, for "Electroplated Coating of Nickel and Chromium".

The illustrations in Figs. 10-12 show blisters produced by the B.N.F. tester.

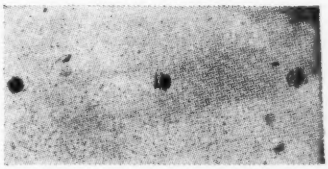

Fig. 10. Blisters produced by B.N.F. test on nickel plated aluminum.

Fig. 11. Blisters produced by B.N.F. test on bright nickel plated lock frame.

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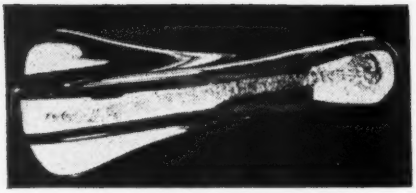

Fig. 12. Blisters produced by B.N.F. test on brass door handle.

The Burgess Battery Company, Handicraft Division, makes a device called the Vibro-Tool. It is the opinion of the representatives of this company that this tool could be used for the test as well as the one made by the W. Canning & Company, Ltd., in England. The Burgess Company has contributed a Vibro-Tool for experimental purposes.

The Ollard Test

The only quantitative method, the results of which can be expressed in pounds per square inch, was first described by E. A. Ollard in 1925. Since that time a few changes have been made by others which have materially improved the accuracy, but it is still known as the Ollard method and a variant as the Micro-Ollard method.

The literature survey showed that it is extensively used, but largely for research purposes. It takes too much time, requires too much expert machining and too expensive equipment to become generally used on production parts.

Numerous references have been made to it in the private communications. Some of the comments are given below:

A. H. DuRose (Harshaw Chemical Co.) states: "Methods such as the Ollard test, while giving 'comparable' results, do not tell a plater whether with his particular electrodeposit, base metal and method of cleaning and pickling he is obtaining good or poor adhesion and consequently he must rely on filing, grinding or bending tests."

C. L. Faust (Battelle Memorial Institute) states: "For securing information on the effect of surface treatments and cleaning prior to plating we have used what is essentially the Ollard method."

R. O. Hull, R. O. Hull & Co., has the following comment: "In my opinion the most accurate method available for measuring adhesion is the Ollard test. It is unfortunate that this test has such limited application. For example, I do not believe that it can easily be made adaptable to the soft metals such as cadmium, tin, lead."

The International Nickel Company has probably done as much work as anybody else in this country on the problem of adhesion. W. A. Wesley commented:

"We have done little with qualitative methods because we think their use makes for a waste of time. I am enclosing a copy of Roehl's paper on 'Adhesion of Nickel Deposits' which describes the test we regularly employ. I may also mention that B. B. Knapp has devised a quantitative tensile test for adhesion applicable to coatings on sheet metal. He is now preparing a paper which will disclose the details."

The letter from E. J. Roehl contained the following comments:

"We have further refined Ollard's method and hope to have sufficient data shortly to warrant publication. We are quite satisfied with this test and with a similar test for sheet specimens, so that our work has been confined almost entirely to pre-treatment methods for good adhesion."

The Micro-Adhesion Test

One of the largest manufacturers of automobiles has modified the Ollard method into what is known as the Micro-Adhesion Test. A communication contains the following information:

"Up to the present time we have applied the Micro-Adhesion test to silver and nickel deposits on steel. It appears from our experience that it is necessary to have a plate thickness after machining of at least twice the wall thickness of the test specimens. This wall thickness, as derived from the prints, will be between 0.009 and .0105 in. When lower thicknesses of plate are applied, it is possible, after machining, to plate specimen to the necessary .021 in.

"There is no detrimental effect of increasing the thickness of the plate beyond .021 in. Below this thickness, if the adhesion is good, the deposit will fail in shear instead of tension. When this occurs the value obtained is inevitably lower than it would be if the failure were in tension. This test, then, measures the adhesion only when the bond strength is less than the tensile strength of the weaker of the two

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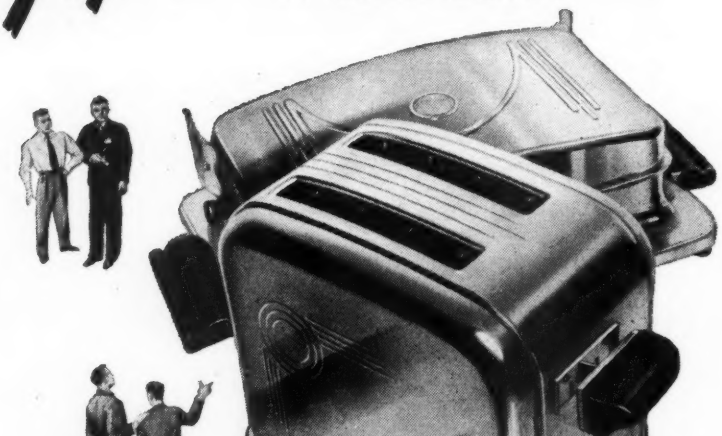

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metals. When it is higher, failure occurs either in the plated metal or the base metal. This test could be applied to any combination of base metal and deposit providing both can be machined. We estimate the accuracy of the method to be ±3.5%. Actual duplicate runs have varied from .4% to 4.5% from the mean.

"Heat treatment will have no effect on the accuracy of the result; however, tensile failures of specimens which have been annealed will naturally occur at lower values, Thin underlying layers or 'flash' coats have no effect on the accuracy of the values obtained. The result is simply the tensile strength of the weakest layer or bond in the system."

The Solder or Adhesive Test

A highly desirable quantitative method is one in which there is attached in some manner a handle to the deposit, or possibly two handles, one to the deposit and the other to the base metal. The handle and the base metal or the two handles are held in a tensile machine and the bond strength determined in pounds per square inch. One of the first methods for the determination of adhesion was of this type. It is known as the Burgess method and was proposed by C. F. Burgess in 1905. The method as used by him consisted in soldering, by means of a low-melting solder, a copper lug about one-half inch in diameter to the surface. Special arrangement was used to prevent the solder from flowing on the zinc surface. A spring balance was used to record the pull necessary to separate the plug from the iron base metal. Burgess appreciated the fact that the high temperature required might influence the adhesion. It was his opinion that the heating would decrease the adhesion of an electrodeposited metal. Because of this objection, the method was practically discarded until a few years ago. Recently, after heating had been specified as an adhesion test, in some instances by the Government, the method has been revived and is being fairly extensively used, in some instances as a quantitative method. After the soldering procedure had been discredited, several other devices such as cements and adhesive tapes employing the same basic principle were used and are still being used. Many of the private reports contain remarks concerning such tests.

R. A. Ehrhardt reports as follows on the solder method used by Bell Telephone Laboratories:

"We are not interested in obtaining adhesion much greater than the strength of 50-50 lead-tin solder, and as our plating techniques improved we found that all of our joints were breaking in the solder. Consequently, we have stopped making quantitative tests and test by making soldered joints to the surface of the panel, breaking them and observing whether the failure occurs in the solder or in the aluminum-electrodeposit interface. In doubtful cases we attempt to resolder since the aluminum surface, if exposed, will not wet with solder. Since we have not made any tensile tests for some time, we do not have any sample joints available.

"Concerning the effect of soldering on the normal adhesion of electrodeposits, we realize that it is subject to criticism. Our chief purpose in plating aluminum was to form soldered joints. We have every reason to believe that with many electrodeposited coatings, heating will lower the adhesion, particularly where the base metal contains absorbed gases which cause blistering. The temperatures required for soft soldering are, however, not very high and probably no higher than those developed in a surface during buffing. Heating to higher temperatures will, of course, cause alloying of the deposit with the base metal in many cases. It is difficult to predict the effect, since in some cases this will improve the adhesion and in others, such as zinc and copper, the alloy layers are brittle and poor adhesion results. Possibly some of the new adhesives will permit bonds to be made at lower temperatures and eliminate the temperature factor."

C. H. Sample, then also with Bell Telephone Laboratories, Inc., furnished additional information on this work:

"In Mr. Ehrhardt's work, we were interested essentially in producing adherent and easily solderable coatings on aluminum surfaces, and he worked out a simple test by means of which one could determine whether or not the aluminum to coating bond was at least as strong as the solder employed. We were primarily interested

in soft solders, but I understand that in certain instances in which hard solders were employed as the bonding agent, adhesion values equivalent to the strength of the aluminum base metal were obtained.

"In this method aluminum test specimens 4 in. x 1 in. x 1/16 in. were plated with the coating under investigation. The edges on the long sides were milled flat prior to plating. After plating, 1 in. x ⅛ in. x 1/16 in. pieces were cut from the 4 in. specimen and by means of a suitable jig were soldered to copper strips of the same dimensions, thus providing a tensile test specimen 2 in. in length. Excess solder and coating were removed from the surfaces surrounding the joint, leaving a ⅛ in. x 1/16 in. rectangle of soldered coating to be tested. Consistent results were obtainable by this method, although, of course, no adhesion strength data could be had higher than the breaking strength of the solder employed. When the break occurred in the solder, the adhesion of the coating was considered satisfactory."

R. O. Hull makes the following comments:

"Some studies of adhesion was made at du Pont by the application of a strong, low melting point alloy and then determining the relative force required to pull the plated metal from the base metal, with the adherent low melting point alloy as a handle or means for gripping the plated coating. It is quite possible that this method could be standardized to give reproducible values which may be translated into specifications."

Probably the most extensive and precise work of this type done recently, was in the Research Laboratories Division of General Motors Corporation. W. M. Phillips, Head of the Electrochemistry Department, reports as follows:

"The following is an outline of an adhesion test used to determine the bond strength between electrodeposited silver and the base metal. The test was designed chiefly for testing the relative adhesion of .010-0.15 in. thick deposits of silver, plated under various conditions. The test does not lend itself readily to testing the adhesion of thin deposits on complex shapes. It is doubtful that it could be applied to anything except the special test pieces used, since a flat surface and an expendable test specimen are required.

"The measurement of the bond strength of the electroplated silver is made as follows: The top surface of the head of a half inch hex head bolt is ground and plated with silver to the required thickness. The surface of the silver is then ground, with light cuts to avoid flowing, and is then soldered to another similar surface or to an unplated, ground bolt head. The two bolts are then pulled apart in a standard tensile machine. The ultimate stress required furnishes a measure of the strength of the bond between the silver and the steel base.

"The method as outlined has not been developed to the extent that it can be used to evaluate the strength of strong bonds of electroplated silver to steel. It can be used to show that the bond strength is greater than 22,000 psi and poor adhesion can be evaluated up to 22,000 psi."

A surprising number of the reports indicate a use of the simple qualitative test with an adhesive. The probable reason is the strong desire for a simple, quick and non-destructive test. Several of the more interesting ones are quoted below:

R. V. Miner, Chief of the Crossbar Finishing Department, Hawthorne Works, Western Electric Company, remarks:

"Extremely poor adhesion has been evidenced by raising the deposit with a piece of scotch tape."

H. Morrison, Cycle-Weld Division, Chrysler Corporation, expresses an opinion as follows:

"We have not had very much experience in the use of adhesives for the purpose of determining the adhesion of metallic coatings. We have, in a few instances, been able to pull off cadmium and zinc plates, but are of the opinion that they were not indicative of the best plated coatings. However, it may be possible through an intensive study to employ adhesive joints in such tests."

C. F. Nixon lists the adhesive test among those used by him:

"The adhesive test consists in covering a flat surface with an adhesive tape, allowing it to stand for 24 to 48 hours, and pulling it off. Poor adhesion can be de-

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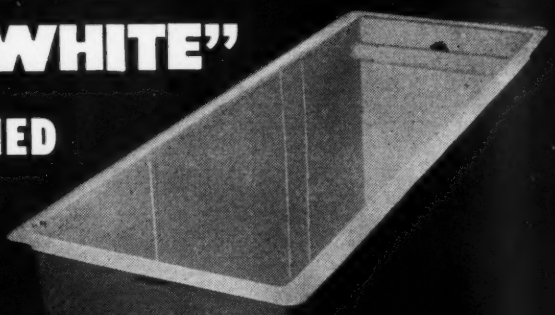

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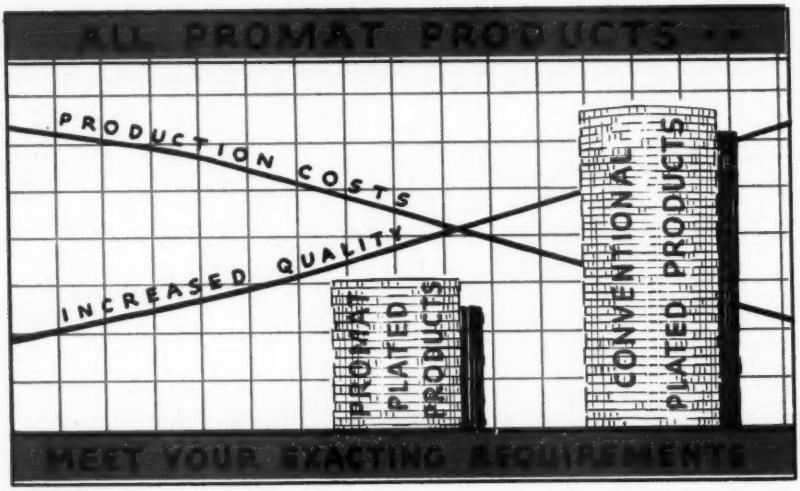

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tected by this method. It is our thought that with a bonding material of high strength, actual measurements can be made of bond strength of a plated metal bond."

V. H. Waite, The McGean Chemical Company, offers the following suggestions:

"Recently developed adhesives, which are said to give metal to metal bonds of great strength, might form the basis for a quantitative test which could be applied to simple shapes. After bonding suitable fixtures to the deposit and the base metal, the force required to separate them could be determined in a tensile testing machine.

"Whether the bond provided by the newer adhesives has sufficient strength, remains to be determined."

Suggested Experimental Work

It will be observed that in some of these reports the opinion is expressed that there is a distinct possibility of developing some method along this line, not only as a qualitative but also as a quantitative test for adhesion. Such a method should be comparatively simple, fairly quick, non-destructive and applicable to both thin and thick deposits. The limitations would be the tensile strength of the adhesive and its adhesion to the metal surfaces under test.

One of the outstanding achievements during the war has been the development of unusual cements and adhesives. Some of the companies engaged in this work were contacted to learn their opinions regarding the application of their cements to the measurement of adhesion of electrodeposits. It appears that none has as yet made such applications, but a keen interest was expressed. An offer of cooperation was extended, and in two instances samples of material with instructions for use were contributed.

One should not overlook the possibility of developing the use of heat or a sudden temperature change under carefully controlled conditions into a valuable qualitative or even a semi-quantitative test of practical value in production. However, work with cements and adhesives is probably most promising. Experiments are now in progress along this line and the results will appear in a later report.

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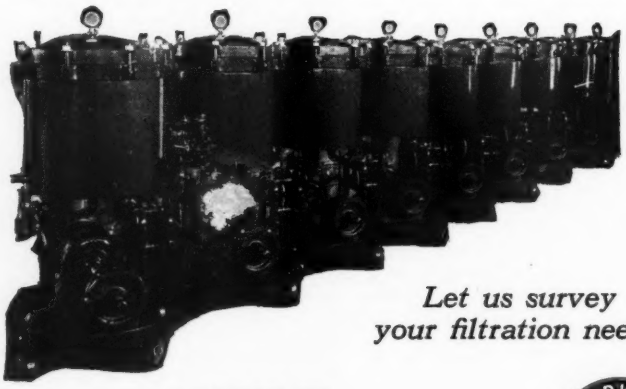

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By FRANK K. SAVAGE

Chairman, Program and Educational Committee

Methods of Preparation of Aluminum for Electrodeposition

ELMER BENGSTON. *Trans. Electrochem. Soc.* **88**, Preprint 25, 13 pp. (1945).

Two general procedures are now available for plating upon aluminum and its alloys. One depends upon the use of a preliminary, chemically applied coating of zinc, and the other upon a preliminary, electrochemically formed aluminum coating. Methods for the application of these procedures are described in detail and the results obtained are evaluated.

LEONARD E. WEEG

Oxalic Acid Etching — A New Pre-Treatment for "Hard" Chromium Plating

C. R. MAKEPEACE. *Metal Industry* (England) **67**, 318-20 (1945).

Etching of steel prior to hard chromium plating appears to (1) remove foreign material, e.g. rust or oxides, (2) remove the outermost "skin" of metal, and (3) provide microscopic roughening of the surface.

A new etching process was developed which appears to offer many advantages over the sulfuric or chromic acid etches: a one-half to one minute anodic treatment in ten per cent solution of oxalic acid with a wetting agent of the sodium aryl sulfonate type at room temperature and six volts with lead or stainless steel cathodes. The part is transferred to the chromium tank without rinsing. Chloride contamination of the etching bath is to be avoided. Current must not be applied until the part is completely immersed to avoid immediate polarization and resulting shallow etch.

The etch has been used for more than a year in the author's plant and has proved very economical and reliable.

L. M. MORSE

The Effect of Various Surface Treatments in Cleaning and Preparing Copper, Nickel and Steel for Chromium Plating

WILLIAM M. TUCKER and ROBERT L. FLINT. *Trans. Eelectrochem. Soc.* **88**, Preprint 28, 21 pp. (1945).

The Hull cell was utilized in a quantitative re-study of the reluctance of certain cathodes to accept a chromium deposit. Results of excellent reproducibility were obtained. It was concluded that the commercial methods of surface preparation evolved since the inception of chromium plating are adequate if certain limiting factors are duly considered. Neither copper nor steel were acutely sensitive to methods of surface preparation. A slight preference in covering copper could be given to a pre-dip in sodium cyanide or to a flash deposit of nickel. Steel could be anodically processed to some advantage in chromic acid, sulfuric acid, or a mixture of the two. With the exception of copper, the chief factors involved in the attainment of the widest bright range entailed the complete removal of oxide and other interfering films from the cathode surface, followed by immediate chromium plating, utilizing precautions designed to prevent reforming of interfering surface films on contact with atmospheric or dissolved oxygen and chromic acid electrolyte.

LEONARD E. WEEG

Magnesium-Copper Sulfide Rectifier

SAMUEL RUBEN. *Trans. Electrochem. Soc.*, Preprint **87**-21 (1945). 13 pp.

The construction and the preparation of the component parts of a dry magnesium-copper sulfide rectifier are described in details. Hard, crystalline discs with pure cupric sulfide surfaces, prepared by sulfiding 15% zinc-copper alloy, are used in preference to the softer discs prepared from pure copper. Permanent low resistance of the contact to the sulfide is accomplished by use of carbonized nickel or carbonized iron washers. During the electric forming process, the surface of the magneisum discs is converted into a film of magnesium sulfide and the adjacent cupric sulfide is converted to cuprous sulfide. To protect the rectifier against deleterious effects of moisture, it is coated with a water proof and heat-resistant varnish. For the majority of applications, single-phase, full-wave bridge and three-phase, full-wave bridge rectifier circuits are used. The operation of the rectifier is purely electronic. Performance characteristics are profusely illustrated.

LEONARD E. WEEG

Chromate Passivation of Zinc

S. C. CLARKE and J. F. ANDREW. *J. Electrodepositors' Tech. Soc.* **20**, 119-138 (1945); *Metal Industry* (London) **68**, No. 2 and 3 (1946).

The authors report results of investigation of coatings of the "Cronak" type. Observations were made of the effect of several variables on the loss in weight, film weight, attack on zinc, and chromium content of film. Based on laboratory results and published information, a recommended cycle is given. Some of the conclusions drawn are:

1. With sodium dichromate constant at 182 grams/liter, and varying the H_2SO_4, film weight was a maximum at 12 ml/l H_2SO_4. Films from high acid baths tended to be less adherent.

2. The effect of varying the dichromate content was very slight.

3. Dilution of solutions of this type to ½ or ¼ strength leads to poor adhesion.

4. The film, as produced, is hydrated, containing about 20 per cent water.

5. Heating this film at 100-200°C renders it insoluble in hot distilled water. Heating the film, however, was shown to reduce its protective value, probably due to reduction of available soluble chromate.

6. The normal iridescent film was reported to have a thickness of 0.00001 to 0.00002 inch.

7. Indications are that after standing a long time, these films become less soluble and that in the long run, the value of the film may be substantially that of an inert protective layer.

L. M. MORSE

Lead Coatings

F. R. MORREL. *Products Finishing* **10**, No. 4, 40-42 (1946).

Since O. Eberling's patent in 1888 on "Mode of Coating Iron Surfaces with Lead" many patents have been applied for. The various processes used for applying lead coatings are: (1) hot dipping, (2) electroplating in acqueous solution (the electrolytes are listed), (3) spraying, (4) fusion, and (5) vaporization.

Some of the 40 references listed in the bibliography are discussed briefly. A few of the peace time applications of lead coatings are mentioned.

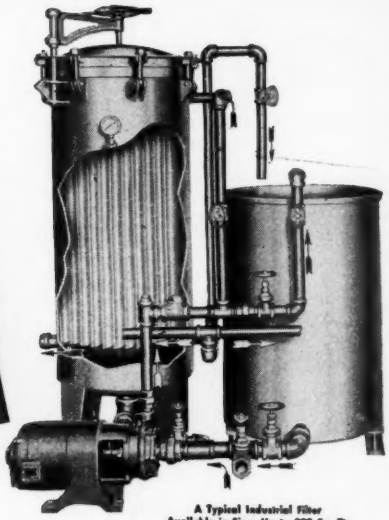
RAYMOND F. LEDFORD

Electricity for the Plater IV

D. A. COTTON. *Products Finishing* **10**, No. 4, 66-70 (1946).

This part of the series explains the principle of magnetic force in relation to the function of instruments for measuring volts and amperes. Nearly all direct current electric meters are based on the galvanometer, in which a movable coil energized by current from the circuit is placed in the field of a fixed permanent magnet. The voltmeter is a galvanometer with very high resistance mounted in series with a movable coil winding, the ammeter is a shunted galvanometer wired in series with the electric circuit, and the millivoltmeter is a meter without the shunt which indicates thousandths of volts.

RAYMOND F. LEDFORD



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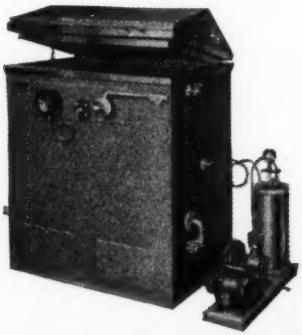

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By DR. HAROLD J. READ

Associate Professor of Metallurgy
The Pennsylvania State College

CHEMISTRY FOR ELECTROPLATERS by C. B. F. Young. Chemical Publishing Co., Inc., Brooklyn, N. Y. vi+205 pages. Price $4.00.

THIS little book, written with the worthy object of presenting the science of chemistry to the electroplater in clear and simple language, is a regretable example of rhetorical obfuscation as well as an unfortunate collection of factual and typographical errors. The author has been so inexcusably careless in his writing and proofreading that glaring errors appear with appalling frequency.

Surveying the work as a whole one finds that the style is labored, the grammar is often more than a little questionable and the continuity of thought is destroyed by the introduction of interpolated and sometimes wholly extraneous observations. Most of the book is written in short choppy sentences which are difficult to read and certainly do not result in the "clear and simple language" referred to on the dust jacket of the book. Such sentences as "Avogadro's theory will help to understand the statement that the molecule of most gases consists of two atoms" form the basis for objection to the author's grammar.

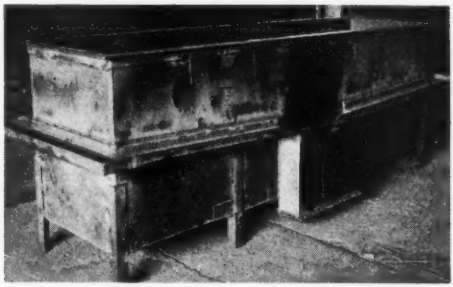
More particularly, the most serious faults of this book are the numerous errors of fact and typography. The reviewer noted literally dozens in his first reading of the text — some are picayune, some serious, but all of them would contribute to the general confusion of a reader seeking to learn the elements of chemistry.

Here is a cross-section of the kinds of errors which have been found: on page 4 density and weight are confused; page 8 is a veritable "black chamber" wherein equivalent weights are given as molecular and atomic weights and the factor is left out of four percentage calculations; one could cite the burning of hydrogen in chlorine as reason for quarreling with the statement on page 11 relative to oxygen and fire; the statement on page 17 that oily rags are spontaneously combustible should be qualified; the definition on page 27 which reads "The temperature at which a material melts is called the melting point, and a temperature at which a material boils is called the boiling point" is not very illuminating; two atoms of hydrogen and one atom of oxygen do not give two molecules of water (page 38); No is not the symbol for nickel (page 42); cyanogen is written as C_2N_2 on page 179 and as $(CN)_2$ on page 180; $KAu(Cu)_2$ is the formula given for an aurocyanide on page 182; the manufacture of ferrochrome is confused with the preparation of chromium metal on page 184; chromic hydroxide is described as being very unstable on page 185 while nothing is said of the stability of chromous hydroxide and a student might well infer that the latter is the more stable.

These and many, many other errors make the book wholly unsuitable for either a classroom text or for self-instruction. It would only increase the burden on the teacher in the first case, and hopelessly mislead the student in the second.

Although the author has tried to make his points clear he occasionally brings in ideas which may be puzzling to the beginner for whom the book was written, e.g., reference is made to 760 mm of pressure without any discussion of the units commonly used in measuring pressure.

The book is quite expensive for its size, but the printing has been well done on smooth white paper.



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BRANCH NEWS

BRIDGEPORT BRANCH

Fifty-six members and guests were present at the "Old Timer's Night" held on January 24 at the Socialist Club House. It was especially nice to have Bill Flaherty, Honorary member of the Branch, at this meeting. Several Old Timers were missing: George Karl, Honorary Member of the Branch who was suffering from an injury, George B. Hogaboom who sent his best wishes, and John C. Oberender who was vacationing at Orlando, Fla., and sent his regrets.

William Ehrencrona, Chairman of the affair, introduced Messrs. Williams and Burns of the Public Relations Office of the New Haven Railroad who described the work of the railroad and showed a moving picture which depicted repairs of locomotives and freight cars and details of passenger service.

Food and refreshments were served in enjoyable "Smorgasbord" style.

George Morrow of the Egyptian Lacquer Company and a member of the Branch, then performed many feats of magic which completely mystified the audience and provided a grand finale to the well managed and delightful evening.

JOSEPH G. STERLING, *Sec'y-Treas.*

BRIDGEPORT BRANCH

Two new members were elected at the January 4 meeting at which 38 members and guests were present.

The Branch expressed its deepest regret and sympathy to George Morrow, a member of the Branch, whose mother had passed away. It expressed its best wishes to J. G. Sterling for the rapid recovery of his son Howard from pneumonia. Howard was in the Marines for 38 months with 28 months' duty in the South Pacific area.

C. C. Helmle, Chairman of the Technical Sessions Committee, announced that open meetings would be held during the months of February, March, April and May.

This Committee was asked to investigate the possibilities of finding larger quarters for the meeting to take care of the increased membership of the Branch.

Librarian Helmle then called upon Dr. W. R. Meyer to conduct a "Question and Answer Program". Many problems were presented and, in most cases, solved by the speaker.

JOSEPH G. STERLING, *Sec'y-Treas.*

TOLEDO BRANCH

Mr. F. L. Clifton and Dr. R. C. Olson of the General Motors Corporation, Detroit, Mich., were the featured speakers at the January 3 meeting. They gave details of the new General Motors specifications for copper-nickel-chromium plating and explained the reasons for the increased requirements. An interesting color picture was shown and many questions from the audience answered.

A correction was made of the previous meeting's report to the effect that the MONTHLY REVIEW would be placed at the Toledo Public Library instead of Toledo University.

Mr. Miner reported on the activities of the Branch Research Committee.

GASTON BERGEMAN, *Secretary*

BOSTON BRANCH

Three new members and one membership application were received at the February 7 meeting.

Plans for the Banquet were announced. It is expected to become an outstanding affair and the members are urged to bring their friends for a day of education and entertainment.

Dr. George E. Morris, formerly an official of the Massachusetts Department of Public Health, in his second appearance before the Branch discussed the very important subject of "Dermatitis in the Plating Room". He recommended the use of large quantities of plain cold water to re-

move acids and alkalies from the hands and the body and advised against neutralization of acids with alkalies or vice versa. A slow drying lanolin or mutton tallow should be rubbed into the skin occasionally. After washing the hands, Lassar's paste consisting of 25 per cent starch, 25 per cent zinc oxide, balance vaseline, should be used as an ointment. Most troublesome are nickel and chromium solutions. They are liable to cause a rash, cracked skin, skin ulcers and perforation of the nose membranes. The attacked areas are subject to infection. To prevent undue contact, one should always wash the hands first and then the forearms. Rubber gloves, aprons and boots should be employed for the purpose of prevention.

Dr. Morris illustrated his lecture with colored slides showing the effects of acid and alkali burns on the various parts of the body. He answered all questions raised by the members during this very interesting evening.

A. W. GARRETT, *Sec'y-Treas.*

CHICAGO BRANCH

Mr. Leo Conradi of Standard Steel Spring Co. spoke on "Corronizing" at the February 8 meeting. He described the process and some of its uses and answered many questions from the audience.

The questions and answer period brought forth the following:

Q. 1. What is a satisfactory method for gold plating 18-8 stainless steel? — A. Make the article cathode in 15 per cent sulphuric acid.

Q. 2 Can streaks and grain of metal be eliminated by anodizing .090 in. thick 2S aluminum in 20 min. at 12 amp/sq.ft.? — A. No.

Q. 3. Which is best, ammonium hydroxide or chloride, in a brass solution for good color? — A. Ammonium chloride was recommended as being more stable. (*Editor's Note:* Ammonia, however, does not cause electrolytic corrosion of steel tanks.)

Q. 4. What is the percentage of current loss where steel tank rods are used instead of copper? — A. For the same size rods the resistance of iron is nine times that of copper.

Q. 5. How can silver be stripped from brass? — A. 1 Immerse in a solution of 5 per cent nitric acid in sulphuric acid at a temperature of 180°F. Add no water. — A. 2. Immerse in a solution of 250 g/l of potassium iodide and 7.5 g/l iodine at room temperature.

M. H. LONGFIELD, *Secretary*

DAYTON BRANCH

Two applications were read for the second time and passed at the February 8 meeting at the Engineers Club.

President Moline asked for suggestions for the program at the Educational Session and Dinner Dance to be held in the near future. Darwin Huff was appointed Chairman of the Exhibits Committee for the National Convention in Pittsburgh.

Librarian Teres than introduced Dr. R. B. Saltonstall, Technical Director of the Udylite Corporation, who talked interestingly on "Bright Nickel Plating from the Engineer's Viewpoint", and answered a variety of questions from the audience.

RALPH CLINEFELTER, *Sec'y-Treas.*

MONTREAL BRANCH

Mr. J. T. Reisenburg of Lea Products presented an interesting paper on "Antique Metal Colouring" at the February 11 meeting at the Mount Royal Hotel. Many members partook in the discussion.

The Membership Committee showed progress by presenting three applications.

WILLIAM L. GLOVER, *Sec'y-Treas.*

SYRACUSE BRANCH

One application for membership was approved at the February 8 meeting.

President Murphy appointed Robert Norton, Herbert Gerhardt, George Simmons, and John Ventura to serve with Bob Colvin, Chairman, Nominating Committee.

Mr. B. F. Lewis, Technical Director of the Northwest Chemical Company, presented a very interesting talk on "Cleaning and Adhesion", and answered a number of questions on practical problems.

NEIL C. MAFFIE, *Sec'y-Treas.*

ST. JOSEPH VALLEY BRANCH

Forty members and guests attended the dinner, and 50 attended the technical session on December 5.

After President John Lockerbie had introduced the guests and new members, Kenneth Harlan gave a report on the choice of a new meeting place.

Librarian Wysong introduced Mr. M. B. Roosa of Parker Rust-Proof Company, who gave a talk on "Phosphate Coatings for the Preservation of Metals". This was followed by an extensive question and answer period.

GEORGE A. BOCK, JR., *Secretary*

ST. JOSEPH VALLEY BRANCH

Thirty-seven members and guests attended the dinner which preceded the technical session on January 9. Two new members were elected.

Librarian R. D. Wysong then introduced Mr. L. R. Davidson, President of the Sturgis Products Company, who gave a very informative paper on "Mechanical Finishing and Deburring by the Use of the Roto-Finish Process". He was capably assisted during the question and answer period by Messrs. Castle and Bogema.

The members were given an opportunity to see some very interesting samples treated by the Roto-Finish Process.

GEORGE A. BOCK, JR., *Secretary*

COLUMBUS BRANCH

The January meeting of the Branch was held on the 25th at the Battelle Memorial Institute. The feature of the evening was a round table discussion of plating problems encountered by the members.

The pending Ohio Chemists Registration Act, membership in The Columbus Technical Society and the Columbus Branch Exhibit at the 1946 Convention, as well as attendance at meetings and membership drive were dealt with.

Mr. Elmer F. Stephan was elected Chairman of the Membership Committee.

Sandwiches and coffee was served at the conclusion of the meeting.

DAVID S. STOKER, *Secretary*

WATERBURY BRANCH

At the meeting on January 11, Dr. George Dubpernell reviewed the latest edition of Field and Weill book on Electroplating and found it to contain much desirable information. Henry Strow briefly discussed new methods of bright nickel plating in barrels at current densities which permit deposition of .0003 in. per hour.

Mr. Bernard C. Case of Hanson-Van Winkle-Munning Company gave a very interesting talk on "Continuous Purification of Nickel Plating Solutions", pointing out that a new and higher standard of plating is required since the war and that it is just as easy to produce high as mediocre quality. He described in detail methods of purification, especially electrolytic methods for removing metallic impurities.

S. L. HENN, *Secretary*

WATERBURY BRANCH

On February 8 the Branch held its regular meeting at the Hotel Elton with Bert Sage presiding in the absence of President W. L. Cassell, who has been ill for sometime. We were happy to learn that he is now recovering and expects to attend the next meeting.

Bert Sage and Henry Strow have been appointed to the Exhibits Committee. It is their duty to get together a collection of plated articles, preferably those having to do with our production for the war effort, for exhibition at the Pittsburgh convention. Every member is requested to check over all available material and advise Henry Strow what he can contribute.

This year's New England Regional Meeting is being sponsored by the Hartford Branch. It will be held at the Hotel Bond in Hartford on May 4. The committees are working hard to make the meeting a success. Everyone should plan to come as both the Educational Session and the entertainment will be better than ever.

Ralph Pettit of the Aluminum Co. of America talked to us on the "Finishing of Aluminum", illustrating his address with a very extensive exhibit of all possible finishes from electroplating to painting. A moving picture in technicolor depicted the history of aluminum from its discovery and early production to today, when it ranks as one of our most useful metals.

S. L. HENN, *Secretary*

TWIN CITY BRANCH

The following guests attended the February 4 meeting: Mr. Edson Bernish of Minnesota Plating Works, St. Paul; Mr. Bill Phelps of Ruehle Plating Co., Minneapolis; Mr. Reg Lohmann of V&L Metalcraft, Minneapolis; Mr. Jorgenson of Minneapolis-Honeywell Regulator Co., Minneapolis; Mr. W. J. Miller and Mr. R. W. Slaney of Detrex Corporation, Minneapolis.

The door prize, an Eversharp pen donated by the Branch, was won by Ben J. Rosenthal of Wyandotte Chemical Corp., Minneapolis.

Gordon W. Lillicrop, Membership Chairman, then introduced two new members. E. H. Lindemann, Chairman of the Research Fund Committee, reported that his Committee was calling on prospective Sustaining Members from whom no response had been received.

Mr. J. W. Dammers of G. S. Blakeslee Company gave an informative paper on "Vapor Degreasing" which was followed by questions from the members.

ROBERT L. BUCKLEY, *Sec'y-Treas.*

LOS ANGELES BRANCH

The January meeting of the Los Angeles Branch was held on January 14 at the Hotel Cabrillo. Visitors were: R. B. Grossman of the Southern California Gas Co., Robert L. Kaas of the Russel Plating Works, Starton MacBurn of the Progressive Plating Works, William Trickey of the Bauers Mfg. Co., W. G. Wood and A. R. Tucker of E. I. du Pont de Nemours & Co., John Drake of Kinnard & Dickie, and W. S. Grange.

Mr. Ray Bauer, of the Southern California and Southern Counties Gas Co., described the industrial fuel situation in Southern California. A sound film in technicolor was shown, entitled "The Pipeline Licks the Weather". Mr. Brossart of the Industrial Filter & Pump Mfg. Co., Chicago, then spoke briefly on filtration.

Four applications were received. The Secretary was instructed to write the Sydney Branch and acknowledge their letter on the subject of "proxies" with a photostat of both letters to the Supreme Society.

Edward Rynkofs reported for the Banquet Committee which held its first meeting on December 17, and presented a tentative line-up of speakers.

Mr. Shaw and Stanley Rynkofs are now out of the Service. The Secretary was instructed to write to Fred Maurer and E. Lamoureaux who were reported ill.

FRANK J. BUNKER, *Sec'y-Treas.*

LOS ANGELES BRANCH

Sixty-five members were present at the February 11 meeting. Visitors were: A. J. Ahlschleger of the Dulite Chemical Co., Paul Smith of Hall-Mack Co., Ernest Hamor of the U. S. Army, B. G. Daw of Lasalco, Clyde Treat of Standard Oil Co., Eddie Noren and John D. Millhorn of Method Chemical Co., B. C. Bartlett of Chemical Process & Engineering Co., S. W. Washburn of Progressive Plating Co., and Ray Warner of Los Angeles Plating Co.

Mike Raskin of Rainbow Processing Co. gave an interesting talk on plating on aluminum and its alloys.

Six applications were voted on and the applicants received into the Branch.

Mr. Rynkofs reported an attendance of 20 to 27 at the Chemistry Class. All reservations for the Educational Session and Banquet to be held on March 23 were spoken for with the exception of a few.

On Mr. Rynkofs' motion it was voted to leave to the discretion of the President whether visitors should be asked to leave before our business meeting or not. Heretofore, visitors have not been permitted to attend business meetings.

The Secretary called attention to the number of men on our rolls who had served in the Armed Forces and suggested that an effort be made to have them return to active participation and membership. The Secretary was directed to obtain a supply of the Constitution for distribution to new members.

FRANK J. BUNKER, *Sec'y-Treas.*

CLEVELAND BRANCH

There were fifty-five present at the meeting on February 1.

Librarian Ralph Schaefer introduced Mr. C. A. Marlies, Director of Research for the Metaplast Company, who, with the help of a blackboard, gave a very complete paper on "Plating on Plastics". He discussed mostly practical methods, their cost and

possibilities for commercial application. Many samples were displayed for inspection.

President Miller announced that Joe Lechner had returned from his tour of duty with Uncle Sam. We are all glad to see him back.

There were four new applications for membership. Chairman E. V. Collins announced the Annual Banquet for March 2. An excellent program has been arranged.

HARVEY P. HEIL, *Secretary*

NEW HAVEN BRANCH

The New Haven Branch held its "Mid-Season Get Together" on January 15. President Walter Lynch welcomed the large gathering and announced that the Seventh Annual Regional Meeting would be held in Hartford on May 11.

The New Haven Branch had the honor of being host to Commander Iliff David Richardson who told about his experiences during two hard years of leading a heroic underground fight on Leyte against the overpowering armies of Japan. Commander Richardson's modestly presented story held the interest of everyone and he received rousing applause.

Following the meeting the members enjoyed refreshments and were entertained by that popular "ivory tickler" Charley Koelbl and our singers, Hank Kellner and Doc Garner.

B. J. GAFFNEY, *Sec'y-Treas.*

NEW HAVEN BRANCH

Technical Chairman Joseph Cooke introduced Mr. Ralph Pettit of the Aluminum Company of America as the speaker at the February 5 meeting.

With a background of some 20-odd years of experience, Mr. Pettit gave a very complete discussion of his subject "The Finishing of Aluminum". It was demonstrated by one of the finest exhibits of commercially finished parts that we have ever seen.

In addition, Mr. Pettit showed a motion picture depicting the early discovery of the metal and present day methods of fabrication and finishing.

B. J. GAFFNEY, *Sec'y-Treas.*

NEWARK BRANCH

Dr. Louis Weisburg, Consulting Chemist of New York City, was the featured speaker at the meeting on February 1. His subject "The Role of Colloids in Electroplating" proved very interesting to the audience and led to much discussion.

Librarian Howard L. Cobb conducted an Information Program which centered around the plating of aluminum and its alloys.

A communication was read from the Executive Secretary, Dr. A. K. Graham, concerning the formation of a committee for the purpose of drafting an amendment to simplify Branch secretarial work, a proposal which originated with Mr. F. L. Clifton, Secretary-Treasurer of the Detroit Branch. President Donroe suggested that the Newark Branch Secretary accept appointment to this committee.

One new member was elected and two membership applications received.

We were pleased to have with us Mr. M. R. J. Andrews, President of the Melbourne Branch in Australia. He expressed his appreciation for the hospitality extended to him during his stay in Newark, particularly by Horace H. Smith and George Wagner.

GEORGE WAGNER, *Secretary*

PITTSBURGH BRANCH

Mr. W. A. Helbig of the Darco Corporation spoke at our January meeting on filtration of plating solutions and especially on the use of activated carbon. He was assisted by Mr. Wurster of Industrial Filter and Pump Company who gave a demonstration of filtration with a portable unit.

Activated carbon is manufactured by the destructive distillation of carbonaceous material. It was first used in plating solutions about ten years ago and has been prominent in the plating field since 1938. It is used in most plating solutions with the exception of chromic acid which is reduced by the carbon to trivalent chromium. Its principal value is in the removal of organic materials, those with the high molecular weight being the easiest to remove. Solutions can be treated either by continuous filtration through a bed of active carbon or by batch mixing in a separate tank for at least 30 minutes followed by filtration. The latter method is the more effective, but should not be carried out in the plating tank.

The proper operation of a filter requires the following information concerning the

filter: (a) Filter area in square feet, (b) Filtration rate in gallons per square foot per hour, and (c) Solids capacity in cubic feet. Carbon weighs 25 lbs. per cubic foot and filter aids weigh about 15 lbs. per cubic foot.

Precoating a filter should be at the rate of 2 ozs. per square foot or about 1/16 in. thickness from a solution of one pound of filter aid per gallon. Filter pressure should not be over 5 psi at start. When it reaches 10-12 psi the filter should be cleaned.

FRANK R. KELLER, *Sec'y-Treas.*

PHILADELPHIA BRANCH

Mr. Joseph Mazia, formerly of Frankford Arsenal and now Metallurgist with the American Chemical Paint Co., Ambler, Pa., presented a lecture entitled "Electrolytic Polishing, Theory and Practice" at the January meeting.

He first traced the history of the process from its discovery by Jacquet in France in 1934, and explained the most commonly used American patented processes, e.g. the Rustless Iron and Steel Company's sulphuric-citric acid method for stainless steel and Battelle Development Corporation's phosphoric-sulphuric acid method for a large variety of metals and alloys.

After stating typical conditions for polishing stainless steel, brass, and plain carbon steel, Mr. Mazia discussed two uses of electropolishing important to the plater: (1) as a method of preparing metals for plating and (2) for electrolytic buffing of plated metals. In many cases electropolishing results in improved adhesion of electrodeposits because it removes the heavily worked or "smeared" metal layer produced in mechanical polishing.

The brush method of electrolytic polishing was advanced as a means of (1) testing baths for possible use in tank polishing (2) polishing discrete areas of large or massive objects, (3) testing certain types of stainless steel for carbide precipitation, and (4) polishing specimens for metallographic examination.

First Vice-President Orlik presented Mr. Mazia with the Hirsch Gold Medal for the best paper presented by a Branch member.

One membership application was received.

PAUL MENTZER, SR., *Secretary*

MILWAUKEE BRANCH

At the 365th Regular Meeting on February 1, the following Library Committee was appointed by President William Geissman to work with the Engineers Society of Milwaukee: Vincent Mattacotti, Milton Johnson, and L. Diveley.

Ted Hartshorn introduced Mr. Ledford of the Hanson-Van Winkle-Munning Company, who spoke on "Impurities of Electroplating Solutions". He discussed in detail the effects and methods of removal of impurities commonly encountered.

JAMES DURNFORD, *Sec'y-Treas.*

HARTFORD BRANCH

Thirty members and guests turned out for the dinner which preceded the educational program at the January 21 Open Meeting.

President Harry Sanders introduced Mr. George B. Hogaboom, Sr. who, after several months' absence, returned with his feature "Latest Developments". Several new patents and articles of particular interest of the past two months were brought to light.

Ted Voyda, Technical Chairman for the evening, then introduced Mr. George Schore of New York City, whose subject was "Electroplating with Acid Copper Baths with Notes on Plastics Plating". Mr. Schore presented a very enlightening paper to an interested group of fifty who plied him with questions afterwards.

Refreshments were served at the conclusion of the meeting.

FRANK W. SMITH, *Secretary*

GRAND RAPIDS BRANCH

The Eighth Annual Educational Session and Dinner Dance on January 26 at the Pantlind Hotel was by all odds the most successful ever sponsored by this Branch. Branch.

The afternoon Educational Session was started off by Dr. A. K. Graham, our Executive Secretary, who presented a clear picture of the aims of the Society and of the good work being done by the Research Committee. He imparted to us the feeling that we are members of a live and worthwhile organization, one that is responsible for making important contributions to the fund of human knowledge.

Mr. L. C. Conradi of the Standard Steel Spring Company gave an informative paper

on "Corronizing", pointing out its advantages and limitations. It was very well received by the members since few of them were well informed on the process.

Dr. A. L. Ferguson of the University of Michigan presented a paper on "Polarization and Overvoltage". It explained many puzzling phenomena that platers encounter.

The session was ably handled by Chairman Stewart Martin, a past President of this Branch who is now with the Standard Steel Spring Company, Coraopolis, Pa.

After a delicious dinner, approximately five-hundred members and guests gave hearty approval to one of the best floor shows seen in this city in several years. It was followed by dancing, which was enjoyed by all.

RAMSON B. PERKINS, *Secretary*

GRAND RAPIDS BRANCH

The regular monthly meeting was held in the English Room of the Rowe Hotel on February 14. Mr. Lewis Euphrat of the Finishes Division of the Interchemical Corporation, Detroit, spoke on "Roller Coating", a subject little known to the members of our group, who asked numerous questions of the speaker following his talk. This widely used finishing process appears to have some important advantages over spray painting and other methods of finishing in certain applications. It is also a fast and economical means of imprinting designs on metal.

RANSON B. PERKINS, *Secretary*

SAN FRANCISCO BRANCH

The February 12 meeting at St. Julian Cafe was opened with a dinner with 28 present. The following visitors were welcomed: Mr. Dent of E. I. du Pont de Nemours & Co., E. F. Wall of Faber Mfg. Co., H. P. Jones of A. J. Lynch & Co., Mr. Herrick of Herrick Iron Works, R. E. Neuhaus of Pacific Rustproofing Co., Mr. Johnson of Mare Island Navy Yard, George Pfleger of Harshaw Chemical Co. and A. Wilkinson of Southern Pacific R.R. Shops.

The opening of a school to teach solution control in cooperation with the Union was discussed. The following committee was named to investigate and report at the next meeting: F. W. Huntington; C. R. MacDonald and J. R. Pattenger, Chairman.

Mr. Paul R. Pine, Technical Director of the Harshaw Chemical Co. gave a very timely and informative talk on "Recent Advances in Plating Techniques". A considerable number of questions pertaining to Bright Nickel were asked and authoritatively answered.

J. R. PATTENGER, *Secretary*

MEETING ANNOUNCEMENTS

NEWARK BRANCH

Our Annual Spring Open Educational Meeting will be held on April 5, at 7:30 P.M. at the Robert Treat Hotel in Newark, N. J.

This is the third of a series of three open meetings sponsored yearly by the Newark Branch. We are deeply gratified at the excellent attendance at these meetings in the past.

To furnish valuable information on electroplating, we have again been able to obtain three outstanding speakers who are well qualified to present their well chosen and interesting subjects.

The speakers and subjects to be presented are as follows:

Myron Diggin — Hanson-Van Winkle-Munning Company, Matawan, N. J. Subject: To be announced.

M. R. Murliss — Monroe Calculating Machine Co. Subject: Finishing of Steel.

K. G. Soderberg — Graham, Crowley & Associates, Inc. Subject: Evaluation of Plated Coatings.

We sincerely hope that all our members and friends will be with us on April 5 to spend an interesting and educational evening in the friendly atmosphere of the Newark Branch.

WILLIAM BRUHNS, *Publicity, Educational Committee*

MILWAUKEE BRANCH

The Milwaukee Branch will hold its Annual Educational Meeting and Banquet at the Schroeder Hotel on April 20, 1946.

The speakers at the Educational Meeting at 2 P.M. are W. L. Pinner, President of the A.E.S., Dr. R. B. Saltonstall of The Udylite Corporation, and Dr. Walter R. Meyer of the Enthone Company. Their subjects will be announced later.

FRED ANDERSON, *Chairman, Publicity Committee*

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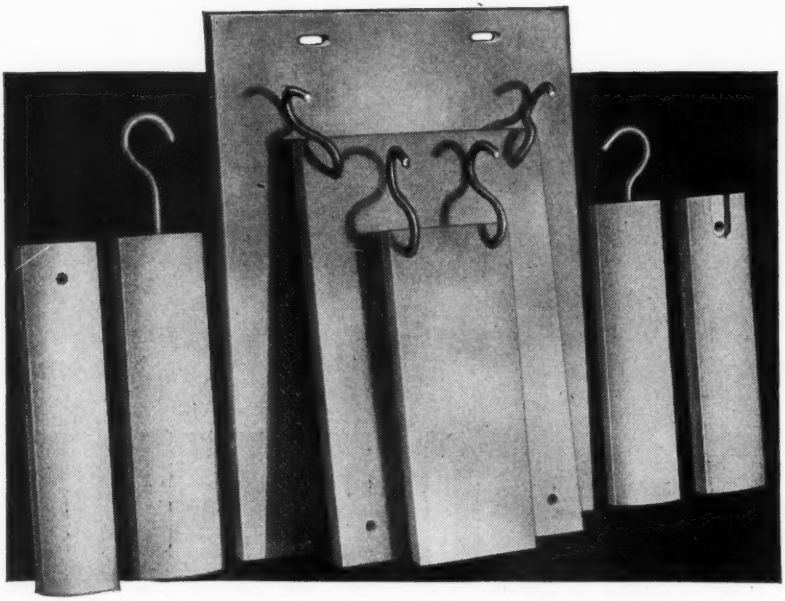

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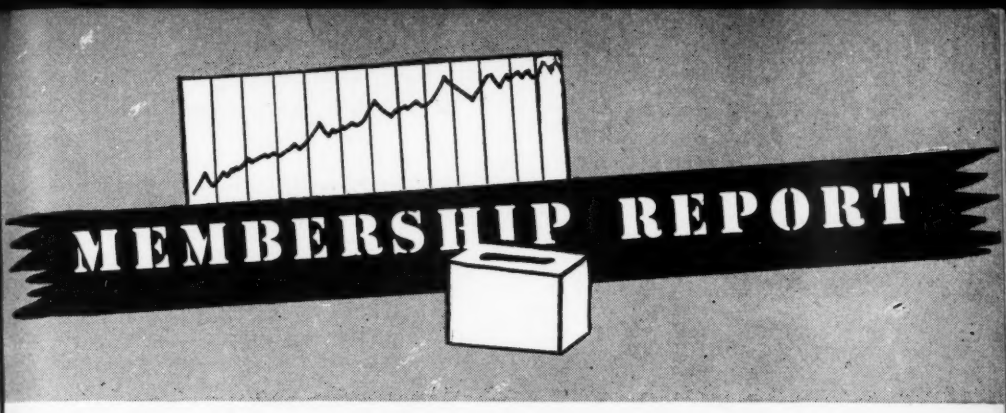

RAYMOND J. O'CONNOR
Chairman, Membership Committee

ELECTIONS

Chicago Branch

R. Walwroth, 906 N. Austin Blvd., Oak Park, Ill.

E. Stack, 10110 S. Emerald Ave., Chicago 28, Ill.

B. Se Breny, 2700 W. 35th St., Chicago 32, Ill.

Toledo Branch

Francis James Crowley, 877 Union Commerce Building, Cleveland 14, Ohio

Detroit Branch

H. A. Babcock, c/o Hurd Lock Mfg. Company, Adrian, Mich.

W. G. Cowell, King-Seely Corporation, Ann Arbor, Mich.

Dr. A. DiGiulio, 1155 Book Building, Detroit 26, Mich.

C. C. Hestand, 1109 Mathews St., Flint, 3, Mich.

M. R. Robertson, 1117 Bishop Rd., Grosse Point Park 30, Mich.

St. Joseph Valley Branch

Calvin G. Smith, 3531 Smith St., Fort Wayne 5, Ind.

George E. Hansen, P.O. Box 475, South Bend, Ind.

William S. McDowell, 2208 South Main St., Elkhart, Ind.

Buffalo Branch

Zina Cummings, Chartlottville Rd., Newfane, N. Y.

Stanley J. Beyer, 98 Dante Place, Buffalo, N. Y.

Foster H. Poland, Art Metal Construction Company, Jamestown, N. Y.

Richard M. Blake, 356 Linden Ave., East Aurora, N. Y.

Toronto Branch

Clifford S. Mason, 9 Redpath Ave., Toronto, Canada

Leonard S. Larkin, 1 Winnington Rd., Enfield, Middlesex, England

David P. Fleming, 182 Rebecca St., Hamilton, Ontario

William T. Fretwell, 56 Wood St., Toronto, Canada

Kergan Wells, 370 Victoria St., Toronto, Canada

James J. Hogarth, 10 Nursewood Rd., Toronto, Canada

Dayton Branch

Robert J. Deisenroth, 309 Drury Lane, Troy, Ohio

Elmer W. Rehme, 505 Commercial Building, Dayton, Ohio

Twin City Branch

Howard J. Hawkins, Hawkins Chemical Company, 740 North Washington Ave., Minneapolis 1, Minn.

San Francisco Branch

William Roger Stoll, 235 Second St., San Francisco 5, Calif.

James C. Standley, 1659 San Pablo Ave., Berkeley 2, Calif.

Boston Branch

Alphonso Ferullo, 54 Fay Rd., Framingham, Mass.

John F. Haggerty, 3 Curve St., Framingham, Mass.

Robert G. Jamieson, 91 Bryn Mawr Ave., Auburn, Mass.

Rochester Branch

B. F. Dewey, Lapp Insulator Company, Le Roy, N. Y.

Emory E. McClelland, Lapp Insulator Company, Le Roy, N. Y.

Clinton H. Murray, 215 Mercer Ave., Rochester, N. Y.
Edgar J. Hollister, 55 Elmore Rd., Rochester, N. Y.

Waterbury Branch
William C. Giesker, c/o United Chromium, Inc., P.O. Box 1229, Waterbury 90, Conn.

Newark Branch
David G. Fallen, 31 Boyd Ave., Jersey City 4, N. J.
Robert Leonard Hyett, "Kenilworth", Hall Rd., Cheltenham, Glos., England

Baltimore-Washington Branch
Dr. Carl A. Zapffe, 6410 Murray Hill Road, Baltimore 12, Md.
Albert G. Taylor, 3002 Ferndale Ave., Baltimore, Md.

Cleveland Branch
Walter E. Taves, c/o Chromium Corp. of America, 1760 Lakeview Rd., Cleveland 12, Ohio
Clayton D. McConkey, 12026 Clifton Blvd., Lakewood 7, Ohio
John J. Tyner, c/o Wyandotte Chemical Corp., 1102 Midland Bldg., Cleveland 15, Ohio

Jackson-Lansing Branch
Thomas F. Keegan, Lansing Engineering Company, Lansing, Mich.
Richard R. Carper, 915 Farrand St., Lansing 6, Mich.
Roy Fisher, Hilfinger Plating Company, Jackson, Mich.
Kenneth Kingsley, 310 E. Hillsdale St., Lansing, Mich.
John S. Hart, Miller-McCluskey Plating Co., 502 E. Prospect, Jackson, Mich.
George A. Braun, 205 W. High St., Jackson, Mich.
William F. Labus, 516 Robert St., Lansing, Mich.
H. T. Graham, 934 Clark St., Lansing, Mich.
Bert A. Payne, 425 N. Francis St., Lansing 12, Mich.
G. H. Williamson, 1721 South Muirland, Detroit 21, Mich.

APPLICATIONS

Cleveland Branch
Elmer E. Larson, 1321 Broadlawn Ave., Cleveland 9, Ohio

Baltimore-Washington Branch
Y. Yang, 715 Lawrence St. N.E., Washington, D. C.
John Samuel Brown, 4725 Third Place N.W., Washington, D. C.
Hugo Starck, 1830 S St. S.E., Washington, D. C.

Columbus Branch
Cloyd A. Snavely, Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio

Bridgeport Branch
Edward W. Leverett, 1043 East Main St., Stratford, Conn.
Carl E. Wrinkel, 82 Scofield Ave., Bridgeport 5, Conn.

Boston Branch
Alfred T. Clarke, 86 Munroe St., Roxbury 19, Mass.

Chicago Branch
V. Finston, 1629 S. 55th Ave., Cicero 50, Ill.
R. Batina, c/o Western Electric Co., Dept. 7728, Hawthorne Sta., Chicago 23, Ill.
J. Schmidt, 1534 Diversey Pkwy., Chicago 14, Ill.
A. Olsen, 3630 North Whipple St., Chicago 18, Ill.

REINSTATEMENTS

Buffalo Branch
C. J. Menzmer
C. Baer

Dayton Branch
Clarence Van Derau
Walter Carlson

Chicago Branch
J. A. Gorz

TRANSFERS

John W. Leever from Dayton Branch to New York Branch
W. A. Hopkins from Dayton Branch to Detroit Branch
Paul J. Kluber from Twin City Branch to Milwaukee Branch
Harold A. Skinner from Columbus Branch to Detroit Branch
Gustaf Soderberg from Detroit Branch to Philadelphia Branch
R. P. Durham from Detroit Branch to Jackson-Lansing Branch

L. J. Major from Chicago Branch to St. Joseph Valley Branch
L. E. Weeg from Chicago Branch to St. Joseph Valley Branch
M. P. Moore from Chicago Branch to St. Joseph Valley Branch
Patrick V. Romano from Waterbury Branch to Springfield Branch

RESIGNATIONS

Montreal Branch
C. Doherty

Chicago Branch
J. Kremer

Columbus Branch
Jesse V. Parker

SUSPENSIONS

Chicago Branch
W. H. Armstrong
C. F. Bellm, Jr.
J. E. Brady
M. F. Brenan
A. F. Cardenas
H. P. Conrad
J. W. Fox
H. L. Garvens
J. H. Greenberg
O. Henninger
V. P. Kaufman
O. Knutson
R. W. Littejohn
G. C. Loss
W. F. McCarthy
C. W. Manz
L. H. Moulton
H. F. Pruter
E. W. Rickmeyer
W. Spence
R. R. Stark
G. E. Williams

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Theodore F. Robak
Louis Abend
Peter P. Rzezuski

Toronto Branch
M. Novak

Dayton Branch
Anglo Corna
Vivian Garrision
Frank R. Jacobs
M. C. Jewett
George Loesch
Willis O. Park
R. H. Tate
Clarence VanDerau
Fred Zempter
Jacob Zwisler

Montreal Branch
G. Bonin
L. Dion
C. A. Mather

Lancaster Branch
Charles Bowers
Ellis D. Hunter
Joseph B. Kistler

DEATHS

Toronto Branch
H. Hands
Detroit Branch
James W. Higgins
Boston Branch
Joseph Barron

Joseph Barron

Joseph Barron of the M. E. Baker Company, Cambridge, Mass. and a well known member of the Boston Branch, passed away in his sleep on Sunday, February 10. The immediate cause was a heart attack. He leaves behind him a wife and three children, ten years, five years and one week old respectively.

The Boston Branch has lost one of its most interested and active members. Many will remember him as the very active General Chairman of the successful Convention held at Boston in 1941.

James W. Higgins

It is with sincerest regret that we announce the passing of James W. Higgins on February 17.

Mr. Higgins, Asst. Chief Metallurgist of the Packard Motor Car Company, was a Past President of the Detroit Branch and had been active in the affairs of the Society for twenty years.

All who knew him admired his spirit of joviality and good fellowship, both in business and social contacts.

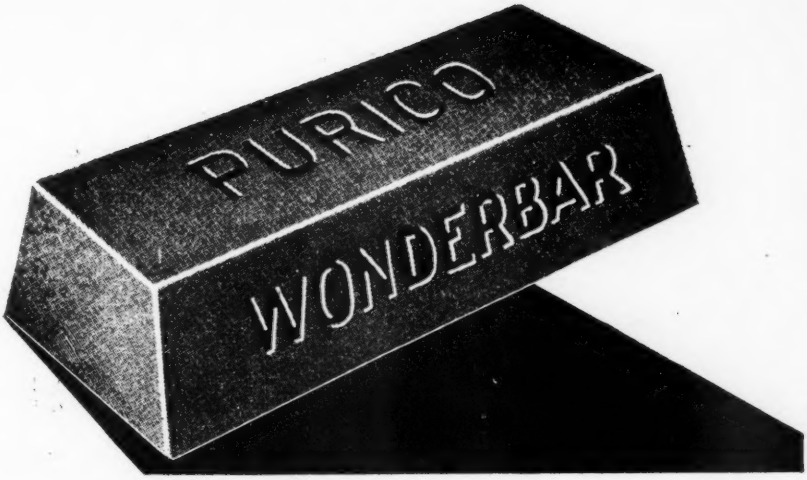
His passing will be mourned by his many friends.

MEMBERSHIP CHART

BRANCH	May 1945	Change in Membership	Percent Change
FIRST GROUP			
CLEVELAND	143	+19½	+13.6
LOS ANGELES	151	+18½	+12.2
PHILADELPHIA	154	+13½	+ 8.8
DETROIT	390	+34	+ 8.7
NEWARK	213	+15	+ 7.0
WATERBURY	122	+ 8½	+ 7.0
BALTIMORE-WASH.	122	+ 7½	+ 6.1
NEW YORK	191	+11	+ 5.8
BOSTON	157	+ 4½	+ 4.5
HARTFORD	126	+ 2½	+ 2.0
GRAND RAPIDS	121	+ 1	+ 0.8
CHICAGO	357	+ 2½	+ 0.7
SECOND GROUP			
TORONTO	119	+12	+10.1
PITTSBURGH	80	+ 7½	+ 9.4
ROCHESTER	90	+ 8	+ 8.9
PROV.-ATTLEBORO	101	+ 8½	+ 8.4
MILWAUKEE	107	+ 6½	+ 6.1
BRIDGEPORT	118	+ 6½	+ 5.5
BUFFALO	89	+ 1½	+ 1.7
SPRINGFIELD	73	+ 1	+ 1.4
INDIANAPOLIS	112	+ 1	+ 0.9
ST. LOUIS	116	+ ½	+ 0.4
NEW HAVEN	106	— ½	— 0.5
DAYTON	109	—10	— 9.2
THIRD GROUP			
ROCKFORD	23	+15	+65.2
SYDNEY	51	+31	+60.8
JACKSON-LANSING	62	+18	+29.0
TWIN CITY	52	+14½	+27.9
SAN FRANCISCO	55	+15	+27.3
SYRACUSE	57	+ 7	+12.3
TOLEDO	54	+ 5½	+10.2
CINCINNATI	57	+ ½	+ 0.9
LANCASTER	39	— ½	— 1.3
MONTREAL	54	— 5½	—10.2

Membership May 1, 1945 = 3,972
Membership Mar. 1, 1946 = 4,309

Gain in Membership = 337
Per Cent of Gain = 8.5



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RODINE an inhibitor, confines the action of the acid in the pickle bath to the removal of scale and rust—protects the clean metal, saves acid and produces better pickled work.

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INDUSTRY NEWS

Electrochemical Engineer Wanted

Electrochemical engineer wanted for progressive concern in the middle west. Must have good background of education and experience and capable of developing new methods in processes. MR-3A, MONTHLY REVIEW, P.O. Box 168, Jenkintown, Pa.

Harshaw Again Shipping Chromic Acid in Non-Returnable Drums

The Harshaw Chemical Co. recently announced it will resume shipment of Krome Flake (Chromic Acid) in one trip, no charge non-returnable drums, on which no deposit is required, and to discontinue the use of returnable drums.

Drums on which deposit has been made must be returned before March 31, 1946 to obtain refund.

Deposit drums should be consigned to the nearest Harshaw stock point via truck, freight collect.

Enthone, Incorporated Succeeds Enthone Company

Enthone, Inc., 442 Elm St., New Haven, Conn. has succeeded Enthone Co., manufacturers of plating equipment and supplies. The company was operating as a partnership and the corporation has assumed all assets, liabilities and good will.

The officers of Enthone, Inc. are Walter R. Meyer, President; J. F. Buckman, Vice President and Treasurer; and Clarence C. Helmle, Secretary.

Dr. Meyer has been actively associated with Enthone since 1942, and was formerly editor of *Metal Finishing*. Prior to that he spent seven years with the General Electric Co., Bridgeport, Conn. as Electrochemist and Metallurgist.

Mr. Buckman was associated with the Enthone Co. since its founding and has been actively engaged in the finishing industry for the past 20 years.

Mr. Helmle has been with the Enthone Co. since 1943 and preceding that spent eleven years with the General Electric Co., Bridgeport, Conn. as Chemical Engineer.

Dave Blount Rejoins Magnus

Dave Blount has rejoined the Magnus Chemical Co., Inc., of Garwood, N. J., as Assistant Sales Manager. Mr. Blount left Magnus in 1937 and has more recently been with Red Star Yeast and Products Co. For the past five years he has held the post of Bakery Sales Manager with the latter company. Extensive trade relation activities and frequent convention program appearances have made Mr. Blount a familiar figure in the baking industry.

1946 ASTM Annual Meeting in Buffalo, June 24 to 28, 1946

Several interesting technical symposiums are being prepared for the 1946 Annual Meeting of the American Society for Testing Materials to be held at the Hotel Statler in Buffalo during the week of June 24. Also under way at this time will be the Seventh ASTM Exhibit of Testing Apparatus and Related Equipment and the Annual Photographic Exhibit. In addition to the some fifteen to twenty technical sessions necessary for the program there will be a large number of meetings of the Society's technical committees.

Two of the symposiums which should be of much interest will involve Testing of Parts and Assemblies; the second, covering Fatigue of Materials. The Society for Experimental Stress Analysis is joining with ASTM in sponsoring the symposium on Testing of Parts and Assemblies.

Further topics will include round table discussion on Test Methods of Freezing and Thawing Concrete to Determine Durability, a session dealing with Tools for Identification of Water Formed Deposits, and a Symposium on pH Measurement.

The Annual Edgar Marburg Lecture, always an outstanding feature of the meeting, will be presented this year by Dr. J. J. Mattiello, Technical Director of the Hilo Varnish Corporation, on the subject "Protective Organic Coatings as Engineering Materials".

A general Committee on Arrangements of ASTM members in the Buffalo District is planning a number of special features for the meeting under the chairmanship of B. L. McCarthy, Wickwire Spencer Steel Company, with T. L. Mayer, Head Buffalo Technical Library, Secretary.

Brown Will Complete Purchase of $500,000 in Equipment in 1946

Installation of $500,000 in new manufacturing, processing and development equipment, started in 1945, will be completed this year, according to Henry F. Dever, president of Brown Instrument Company, Philadelphia industrial instrument division of Minneapolis-Honeywell Regulator Company.

During the past year, said Mr. Dever, the company acquired and installed $250,000 in new and modern machine tool equipment, constituting, he added, part of the

FOR SALE **Available for Immediate Shipment**

1—2500/1250 AMPERE, 12/24 VOLT, **CHARLES J. BOGUE ELECTRIC CO.** Motor Generator Set. Separately Excited. Excellent Condition. Full Controlling Equipment.

1—1500/750 AMPERE, 6/12 VOLT, IMPROVED **AMERICAN GIANT** Motor Generator Set. Complete Controlling Equipment. Excellent Condition.

10—1440/720 AMPERE, 6/12 VOLT, **UDYLITE (MALLORY)** RECTIFIERS. Input Rating: 220/440 volts, 3 phase, 60 cycles. Excellent Condition.

2—750/375 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE CO.** Motor Generator Sets. Excellent Condition. Full Controlling Equipment.

15—125 AMPERE, 7½ VOLT, **HOBART BROTHERS CO.** Motor Generator Sets. Like New. Full Controlling Equipment.

ANODIZING MOTOR GENERATOR SETS

1—1000 AMPERE, 50 VOLT, **CHANDEYSSON ELECTRIC CO.** SYNCHRONOUS-DRIVEN Motor Generator Set, complete with Exciter and Full Controlling Equipment.

1—500 AMPERE, 60 VOLT, **WESTINGHOUSE** Motor Generator Set, Complete with Full Controlling Equipment.

2—500 AMPERE, 40 VOLT, **MOTOR GENERATOR CORPORATION** Motor Generator Sets. Excellent Condition. Full Controlling Equipment.

2—400 AMPERE, 40 VOLT, **MOTOR GENERATOR CORPORATION** Motor Generator Sets. Complete with Full Controlling Equipment.

1—500 AMPERE, 24 VOLT, **HANSON & VAN WINKLE CO.** INTERPOLE TYPE Motor Generator Set. Excellent Condition. Full Controlling Equipment.

M. E. BAKER COMPANY **143 SIDNEY STREET CAMBRIDGE, MASS.**

recently announced overall expansion plan of the entire Honeywell organization. The Philadelphia division will retain additional branch sites, acquired during war years, it was added, and will make other organizational changes for greater worker comfort and operational efficiency.

Tripler at Battelle

Archibald B. Tripler, Jr., formerly a chemist with the Crown Cork and Seal Company, Baltimore, Md., has joined the staff of Battelle Memorial Institute, Columbus, O., where he will be engaged in research in electroplating and electropolishing.

Mr. Tripler has a Bachelor of Science degree from Wagner College and studied additionally at Johns Hopkins University. He is a member of the American Chemical Society and Phi Lambda Upsilon.

H-VW-M Adds to Staff

Further additions to its staff, made earlier this year, have been announced by H-VW-M.

Edward M. Close has been appointed Assistant Purchasing Agent, working with Robert A. Malkmus, head of that department. Mr. Close was graduated from Lehigh University in 1937 with a degree of Bachelor of Science in Business Administration. He was engaged in hardware industry until 1941, following which he served in the Sales Department of Hanson-Van Winkle-Munning Company, Matawan, until November, 1942. From that date until October, 1945, he served as Supervisor of Priorities.

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FUME EXHAUST SYSTEMS

Are designed to meet your individual plant needs. They thoroughly remove fumes and vapors, guard workers' health, increase production and reduce costs.

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Walter J. Jurman, who was with the company for a number of years before the war, and who left to join the Navy, has recently been discharged as Ensign in Naval Aviation and has rejoined the company. Mr. Jurman attended Rutgers University, where he specialized in Business Administration. From 1935 until 1942 he was employed in the Sales and Advertising Departments in Matawan. In February 1942 he enlisted in the U. S. Navy and served overseas in anti-submarine work and, later, flight school. He has been assigned to the Chicago office, where he will be in charge of the Order Department.

Hugh Vincent McGuire was in the employ of the company in 1940, engaged in

cost work in connection with the electrical manufacturing department. In the fall of 1941 he enlisted in the U. S. Navy and at the time of his discharge in October 1945 he held the rank of Ensign in Naval Aviation. He is currently assigned to the Sales Engineering Department at Matawan.

Robert A. Noland has joined the company as a field representative. Mr. Noland attended the Lewis Institute of Technology, where he received the degree of Bachelor of Science in Mechanical Engineering and also received specialized training in metallurgy and chemistry. Prior to going with H-VW-M, he was engaged as Assistant Metallurgist at Buick Motor Division, G.M.C., Melrose Park, Ill. He has been assigned as field engineer located at the Chicago office.

Myron B. Diggin, Chief Chemist of H-VW-M, has been appointed director of Project No. 4 of the A.E.S. Research Committee. This project will consist of an investigation into the effect of polishing nonferrous metals on the protective value of electroplated coatings on them.

THE READER'S CORNER

(*Continued from page* 266)

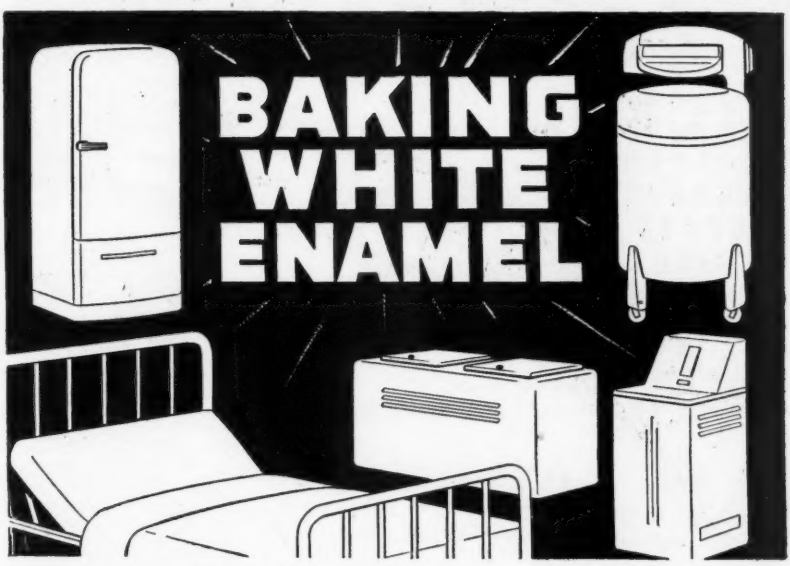
this is a cause of poor bond strength and not poor adhesion.

Finally, *adhesion is the physicochemical concern of inter- and intracrystalline forces,* whereas *bond strength is a mechanical property.* All physical and mechanical tests should be interpreted on the basis of which property is being measured by the test.

Reference should be made to the paper by Zepffe and Faust, Proceedings of 32nd Technical Sessions, pages 93 to 107, for discussion on the manner in which hydrogen in the basis metal can cause brittle layers to form at the interface and thus cause "apparent poor adhesion". For such cases, *adhesion would be perfect* as plated, but the work would age into a state of *low bond strength.*

CHARLES L. FAUST,
Associate Editor

Here is Egyptian's new Baking White Enamel



Resistant to:

ABRASIVES • ACIDS

ALKALIS • SALT SPRAY • HUMIDITY

WATER IMMERSION and

SOFTENING ACTION of FATS and OILS

Spray it on clean bare metal. Needs no primer. Bakes fast to a hard, glossy finish.

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Nickel Anodes Available Now

Approximately 3 Weeks Delivery

Restrictions are off and nickel is available. For that reason, we can make relatively prompt deliveries of Seymour Nickel Anodes — ranging between two and three weeks.

The full line is in production:

99% + Rolled Depolarized

99% + Cast Oxide Depolarized

99% + Rolled Carbon

"Seycast" — designed primarily for Bright Nickel, but fine for any hot Watts bath of 4.5 pH electrometric or lower.

Bright Nickel — for brilliant deposits from a standard hot nickel bath without the usual coloring or buffing.

Also copper, brass, bronze and zinc anodes. Your jobber can supply you.

THE SEYMOUR MFG. CO.

SEYMOUR, CONN., U. S. A.

NONFERROUS ALLOYS SINCE 1878

NEW Equipment Materials Supplies

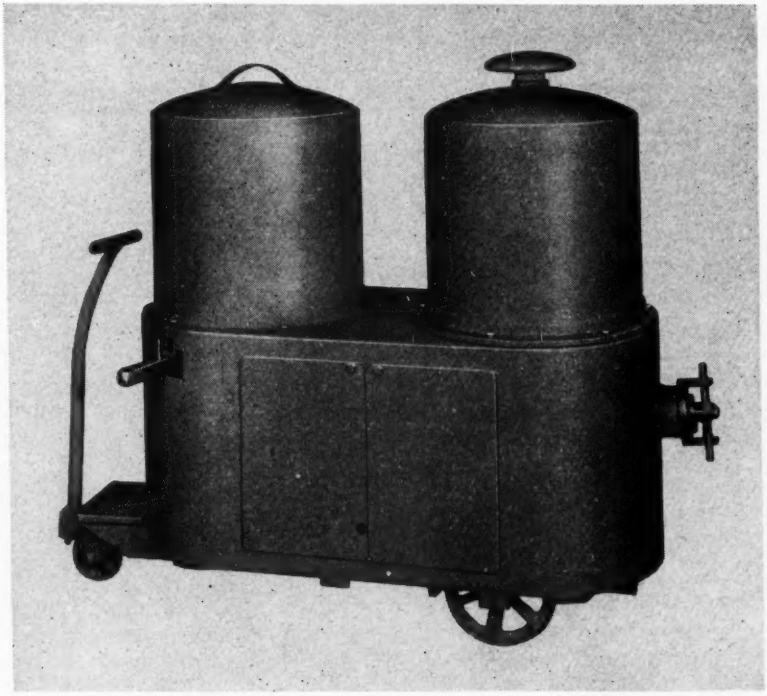
New Automatic Filter for Electroplaters

The new Udylite Automatic Filter for plating room service incorporates a number of advantages not heretofore found in equipment of this type.

For instance, it may be used either for continuous or intermittent filtering. It serves to filter or transfer plating solutions easily and quickly without spilling any of the liquid. It requires no replacement parts. There is nothing to wear out and it can be cleaned without the use of a single tool.

The heart of this unit is a specially designed positive plug type multiport valve which has just one operating control lever. In other words, by manipulating this one lever you can prime the pump, feed slurry, backwash, build filter cake, clean the filter or transfer a solution from one tank to another. It is not necessary to change suction and discharge lines at any time after filtering has begun.

The filtering medium (activated carbon, diatomaceous earth or fibrous material) is



mixed with water or plating solution in the slurry tank and transferred by the pump to the filtering tank.

The filter structure consists of rigid porous ceramic elements arranged radially with a central channel to carry the filtrate. These filtering elements are permanent and need not be renewed. The filter aid is deposited on the outside of these elements to form the filter cake. At any time during the filtering operation, filter aid can be added without interrupting the operation.

The entire unit is fully enclosed and easy to keep clean. It is also easily portable having truck wheels large enough and with sufficient tread to roll over duck boards easily.

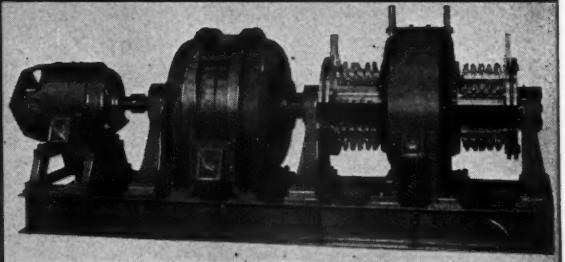
New Type Flex-Disc Manufactured by N. Y. Grinding Wheel Corporation

Greater economy, increased production, and reduction in operational hazards are reported for the Pekay Flex-Disc, an improved type of abrasive disc for metal-finishing for portable sanding units. Departing from the conventional form of a single layer of abrasive particles on cloth or paper, The New York Grinding Wheel Corporation, 623 Bergen St., Brooklyn, N. Y. reports it has produced a modernized disc which combines greater tensile strength, a wider range of compound mixtures and abrasives, augmented durability and reduction in the number of operations.

A homogeneous, flexible mass of great strength is produced by curing together three layers of materials — a bonded cutting layer, a cloth layer, and a fibre disc. A tough resilient rubber compound is used to bond the abrasive particles, producing a bonded layer ⅛" or more in thickness of grit. The second layer is a cloth of high tensile strength, the third a several-ply tough fibre material. The three layers are held together by a tough resilient cement.

While the same hundreds of variables found in conventional grinding wheels are available in this new disc, an increased abrasive range has been made possible. In addition, the Pekay Flex-Disc is available with the leading edge elevated, so that a thicker layer of cutting material is supplied at the point of maximum wear. Discs with grits on both sides for grinding in slots and grooves can be produced.

COLUMBIA MOTOR GENERATORS



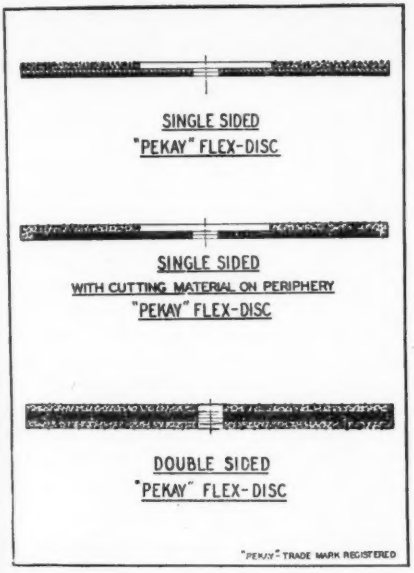
FOR ELECTRO-PLATING

Columbia Generators embody every feature essential for dependable, 24-hour operation. They are built for electro-plating service in sizes of 6 to 20 volts, 500 to 20,000 amperes, for anodic treatment of aluminum in sizes of 40, 50, and 60 volts, 500 to 3,000 amperes. Columbia Generators for other electrolytic processes range from ½ to 250 KW, 100 to 40,000 amperes, 6 to 60 volts. Write for full information.

COLUMBIA ELECTRIC MFG. CO.

4519 HAMILTON AVE., N.E. CLEVELAND 14, OHIO

Chicago Office — 1525 E. 53rd St.



Where sanding units are not portable but stationary, discs can be produced with a plain cloth back for cementing on stationary sanders. The greater area of cutting material on the periphery of the Pekay Flex-Disc, as compared with the thin edge of the ordinary disc, diminishes the danger to the operator of cutting himself.

Increased durability of 10 to 15 times over the conventional type is claimed from actual tests. On some operations a single Pekay Flex-Disc was used continuously for two weeks while the single layer type required replacement before the end of a day. Production is stepped up by eliminating the time consumed in stopping the machine frequently to replace worn discs.

Simultaneous roughing and finishing operations, in many cases, by a single disc of this new type are reported. For example, it has been found that the double operation involving a 36 grit single layer disc followed by an 80 grit disc can be accomplished by a single bonded-layer 46 grit Pekay Flex-Disc. A similar improvement was noted in some forms of butt welding of stainless and carbon steel. Previously the rough weld was de-burred with a resinoid bonded wheel and finished with an 80 grit conventional paper disc. The combined operation was performed, with a superior finish, by a single ER46-L-93 Pekay Flex-Disc.

These improved abrasive discs are manufactured in any diameter up to and including 18 inches. Manufacture of larger diameters is now being contemplated. Any desired bore can be furnished. The standard thickness is 5/32". Thicker discs can be supplied upon request. For highest efficiency it is recommended that Pekay Flex-Discs be run at speeds not exceeding 8500 surface feet per minute.

Pekay Flex-Discs are available on an approval basis for a limited period.

New Richardson-Allen Variable Rectifier Bulletin

Richardson-Allen Corporation, 15 W. 20th St., New York City has just issued a bulletin featuring "Rectifiers — Selenium or Tubes for D.C. Power Requirements." The information pertains especially to single unit, double unit, and custom-built rectifiers for electro-chemical applications. Write Rectifier Engineering Division of Richardson-Allen Corp. for Bulletin MR.

FOR
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Zialite
Reg. U. S. Pat. Off.
Nickel Plating Solution
The one bath especially designed for plating WHITE METAL ALLOYS including ZINC, LEAD and ALUMINUM.
FOR
HARD CHROMIUM
USE
Zialite
ADDITION AGENTS
Send a sample of your present bath to see if it is suitable for conversion to this improved formula.
ZIALITE CORPORATION
143 Exchange Street
Worcester 8, Mass.

New Abrasive and Fume Resistant Ducts

Out of wartime research on gas masks for horses has come a new type of flexible, corrugated duct, made of fabric, rubber and plastics, which is expected to be widely used in the future for conveying air, dust, fumes and abrasive substances on mechanical equipment and in industrial plants.

Watson G. Harding, development engineer of United States Rubber Company, perfected the duct early in the war in response to the Army's request for a light, highly flexible tube, to carry oxygen to the nostrils of horses which might be caught in enemy gas attacks.

Later he adapted the manufacturing process to ducts for heating, ventilating and defrosting American warplanes. By the end of the war he had engineered more than 500 different sizes and types of air conveyors for Army and Navy airplanes.

The ducts — called Multi-Flex — are light and durable and easy to install. They can be twisted and turned around obstructions, saving installation time formerly required to cut and shape metal. They are easily repaired, and if accidentally crushed they resume normal shape as soon as pressure is released. They will withstand temperatures up to 350 degrees F and down to 70 degrees below zero. They are made out of glass and asbestos fabrics impregnated with synthetic rubber and plastics. No wire reinforcements are employed. Flexibility is obtained by means of corrugations.

Ducts have been designed for heating and ventilating automobiles, airplanes, railway cars and other vehicles and for carrying flour, sugar, chemicals and similar substances in manufacturing plants. Many similar products other than air ducts have been made by the same processes, including dust excluder boots for protecting pistons, worm gears and other machine parts against dust, sand, grit and similar abrasives, and bellows for such devices as resuscitators and enlarging cameras.

Optimus Detergents Announce New Floor Cleaner

Optimus Floor Cleaner No. 1F10 has been announced by Optimus Detergents Company, 130 Church Street, Matawan, N. J. This product is a heavy duty floor cleaning compound, especially compounded for use on cement, Terazzo or tile floors.

PEERLESS PRODUCTS

DU PONT'S DISTRIBUTOR

ELECTROCHEMICALS DIVISION

Bright Nickel, High-Speed Copper, Zinc and Cadmium Plating Processes

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GEO. A. STUTZ MFG. CO.

Plating and Polishing Equipment and Supplies

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Although very effective in removing oil, grease and other dirts from the surface, this material does not harm the finish in any way. In fact, regular washings with Optimus Floor Cleaner helps keep floors in good condition, makes them less porous, keeps them from dusting, keeps them whiter and cleaner.

Optimus Floor Cleaner is a base from which a liquid floor cleaner can be made, or it can be applied to the surface directly, and then rinsed off.

Used in lower concentrations, it is very effective in industrial floor scrubbing machines. Available in 150 lb. and 500 lb. containers.

Bristol Publishes New Bulletin Describing pH Equipment

The Bristol Company, Waterbury 91, Conn., has announced a new bulletin, No. pH1302, describing its line of pH Control Instruments.

Bristol Continuous pH Controllers and Recorders are described in detail including electrode assemblies and accessories. The bulletin includes engineering and technical information relative to pH theory and measurement. A variety of actual installations are described; with chart records, photographs, and flow diagrams included.

Copies of the bulletin may be obtained from The Bristol Company.

New Pen-Kote Bulletin

Complete information on the new Pen-Kote 500 chemical-resistant maintenance paint is given in an illustrated bulletin announced by Peninsular Chemical Products Co., Van Dyke, Detroit, Mich.

Illustrations of typical jobs show how this quick-drying, odorless protective coating is readily applied to heated, wet, and porous surfaces of all kinds. Unretouched photographs of test strips demonstrate the protection provided by a single coat of Pen-Kote 500 against hot acids, alkalis and water; and other distinctive features are explained in detail.

This new bulletin is available on request from Peninsular Chemical Products Co., 6795 East Nine Mile Rd., Van Dyke, Mich.

ABBOTT

Quality Controlled

BURNISHING MATERIALS

There's more than seen on the surface — Abbott Burnishing Materials . . . Balls, Pins, Slugs, Cones . . . are given the proper heat treatment to provide the all important "backbone" necessary for an efficient job of Burnishing . . . Abbott Materials are quality controlled! Lower your finishing costs — use Abbott Materials!

Want a sample kit of materials?

THE ABBOTT BALL COMPANY 1046 NEW BRITAIN AVE. HARTFORD 10, CONN.

Data for Electrocleaning Buffed Copper

MacDermid Incorporated, Waterbury 88, Conn., have recently published a data sheet on a new product for the electrocleaning of buffed copper articles prior to any finished operation. This data sheet gives typical cleaning cycles for the proper cleaning of any copper coated article.

Steam Detergent Cleaning

Of increasing interest to plant superintendents and others responsible for machinery and equipment maintenance cleaning are the savings in time, money and effort being effected by steam detergent cleaning methods. A booklet on this subject has been published by Oakite Products, Inc. and is available free upon request.

Described in this booklet are many applications of steam detergent cleaning for (1) cleaning machinery equipment and parts for subsequent repair and overhaul, (2) preparing equipment surfaces for repainting or refinishing, (3) cleaning equipment too large for tank immersion, or where suitable tanks are not available, (4) paint stripping. Emphasis is placed on steam detergent cleaning as a simple, fast method for safely removing grease, oil, dirt, sand and other deposits from all types of equipment through the combination of mechanical force, controlled heat and effective detergent action of recommended materials. Savings of nearly 50 per cent of former costs and over 75 per cent of time and effort are reported on some cleaning operations using this modern method.

Write to Oakite Products, Inc., 40 Thames Street, New York 6, N. Y., for a free copy of their booklet on "Steam Detergent Cleaning".

New Die-Casting Machine

Complete elimination of cold metal from the shot furnace, improved hydraulic performance, automatic timing and improved adjustable bearings for the movable platen are featured in announcement of a new die-casting machine by The Cleveland Automatic Machine Company, just released.

WOW! that's speed!

In only a few seconds—clean and dry. That's the secret of the success and universal acclaim of Blakeslee Solvent Vapor Degreasers. A patented and entirely different cleaning process for metal parts and alloys giving 100% grease-free surfaces. Even pores, cracks, seams and massed parts come through thoroughly clean and grease-free. Write for facts.

BLAKESLEE
Solvent Vapor DEGREASERS
Metal Parts WASHERS

STANDARD AND SPECIALS Engineered for you

G. S. BLAKESLEE & CO., CHICAGO 50, ILLINOIS
NEW YORK N. Y. TORONTO, ONT.

The new machine, designated as Model 400, Universal High-Pressure Hydraulic, is available for zinc, tin, lead casting or for magnesium, aluminum, bronze or brass.

Important among the many improved features is a double compartment furnace, on the zinc, tin-lead machine, with separate automatic burners for each compartment which does away with cold metal in the shot compartment. New metal is placed in the second compartment, automatically causing the overflow of readied molten metal into the shot section. Even temperature and uniform condition of the shot metal are maintained by this method.

Although the basic Cleveland design has not changed, including the interchangeability of hot metal ends, appearance of the machine is entirely different. All toggle and pump mechanism is entirely enclosed in steel guards. Ease of maintenance, as well as modern appearance, have been improved over previous models by the streamlined guards, all of which are removable to permit ready access to working parts.

Cleveland Die-casting Bulletin 400 giving details of the machine will be sent on request to the Cleveland Automatic Machine Co., Cleveland, Ohio.

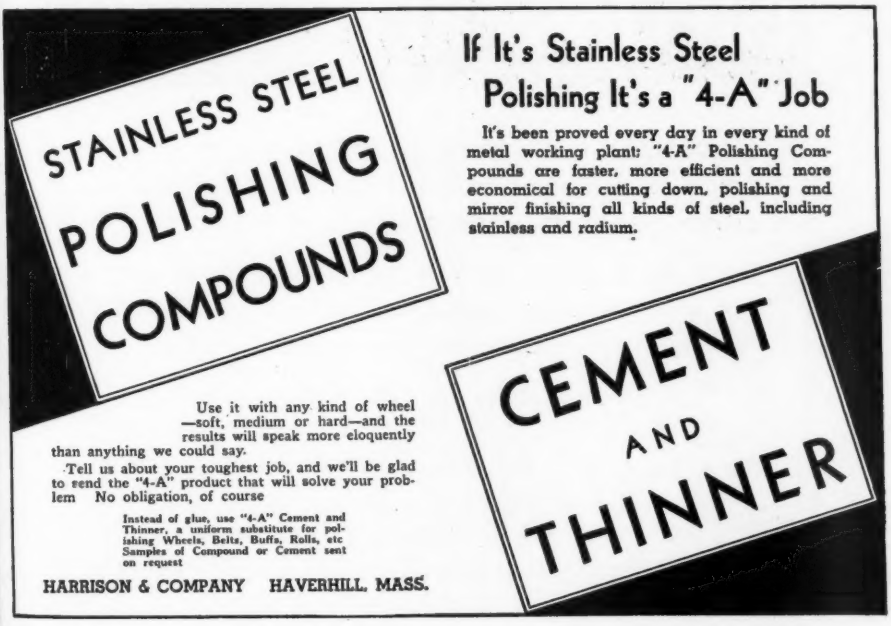
New Illustrated Book Covers Field Of Metal Cleaning and Finishing

An attractive 48-page book containing over 80 photographic illustrations and detailed information on the design and application of Howard metal cleaning and finishing machinery has been prepared by the Howard Engineering & Manufacturing Co., 2294 Buck Street, Cincinnati 14, Ohio.

All features of Howard Machines are fully, clearly described — including their engineering design and construction, adaptability to every phase of metal cleaning and finishing, ease of control, and automatic operating devices. Numerous improvements pioneered by Howard and available only in Howard machines are also illustrated.

Among the types of machines illustrated and described are: Cabinet Type and Conveyor Type Metal Cleaners and Finishers, Monorail Washers; Rotary Washers; Small Parts Washers; Tumbling, Deburring and Burnishing Machines; Hot Air Dryers and Ventilators, and Solvent Cleaners.

There is a separate section on machines of special design, custom-built by manufacturer to meet unusual requirements. An


STAINLESS STEEL
POLISHING
COMPOUNDS
If It's Stainless Steel
Polishing It's a "4-A" Job
It's been proved every day in every kind of metal working plant: "4-A" Polishing Compounds are faster, more efficient and more economical for cutting down, polishing and mirror finishing all kinds of steel, including stainless and radium.
CEMENT
AND
THINNER
Use it with any kind of wheel —soft, medium or hard—and the results will speak more eloquently than anything we could say.
Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem No obligation, of course
Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc Samples of Compound or Cement sent on request
HARRISON & COMPANY HAVERHILL, MASS.

important feature of the book, too, is profusely illustrated details of construction, information which engineers will particularly appreciate. There is also an exhaustive treatment of the various processes involved in metal cleaning and finishing. This catalog is available without charge if requested on your business letterhead.

Bristol Publishes New Post-War General Catalog

A new post-war general catalog entitled, Specification Index for Bristol Instruments, has just been published by The Bristol Company, Waterbury 91, Conn. The catalog, No. W1800, contains 24 pages of information on the Bristol line of automatic controlling, recording, and indicating instruments and gives hints on how they can be used effectively to save time, and money and promote efficient operation. Specification data is given on each instrument listed. The booklet is liberally illustrated with line drawings, which show basic methods of applying various types of industrial instruments.

Emeloid Company Issues New Catalog

The Emeloid Co., 286 Laurel Ave., Arlington, N. J. has just issued a new 24-page catolog, "Plastic Advertising Specialties of Distinction". This booklet should prove of interest to any firm desirous of keeping its name constantly where it will be seen and remembered. A wide variety of attractive and inexpensive advertising specialties which fit the needs of practically any type of business are illustrated in actual size.

The Emeloid Company states that these plastic advertising specialties are each designed for a definite, practical purpose and will do an effective job of building good will and stimulating sales, used either by themselves or as an adjunct to other forms of advertising.

One of the most completely equipped plastics plants in America, Emeloid also offers its facilities in producing advertising specialties custom-made to individual requirements.

PRECIOUS METAL SALTS

Merck Precious Metal Salts are manufactured by precision methods. The finished products must meet extremely high standards for purity and uniformity.

Every plater knows that purity and uniformity are two qualities which supplement the operator's skill in producing a satisfactory plating job.

Prices will be mailed on request.

MERCK & CO., Inc. *Manufacturing Chemists* **RAHWAY, N. J.**

New York, N. Y. • Philadelphia, Pa. • St. Louis, Mo. • Elkton, Va.
Chicago, Ill. • Los Angeles, Cal.

In Canada: Merck & Co., Ltd., Montreal • Toronto • Valleyfield

Hermetically Sealed Rectifier Invulnerable to Extreme Temperatures

A newly developed selenium rectifier can be submerged in boiling water or packed in ice and still turn alternating current into direct current at an efficiency equal to that obtained under normal operating conditions, a performance never before achieved with a plate type rectifier.

The new rectifier, a product of seven years of secret research and development by engineers of the Westinghouse Electric Corporation, consists of a heavily tin plated, hermetically sealed container inside which is placed selenium suspended in oil. It was designed to keep pace with the exigencies of war. It has unequaled invulnerability to high and low temperatures, a quality which insures top performance in any climate from the North Pole to the Equator.

Many unfortunate experiences on battlefronts occurred when the ordinary converting device failed to operate while exposed to heat which mounted as high as 150°F, or to cold far below zero. Motors, relays, signal lamps, controls, and most important of all, radio and radar quit working. Frequently the rectifiers were ruined and had to be replaced.

An example of a common hazard to rectifier performance is that of a bomber which may stand for hours under the burning tropical sun, then takes off and a half hour later is flying through the sub-zero temperatures of the stratosphere. The usual rectifier decreases markedly in efficiency as either heat or cold intensifies beyond a certain range; and breaks down completely when the surrounding temperature gets to about 150°F or to 40° below zero F. The plane is then left without communications and other accessories which depend upon direct current from converters. This new selenium rectifier will keep right on working under the most extreme conditions of temperature.

Industrial electrical control devices; transformers, resistors, vacuum tubes, rectifiers and other heat-dissipating apparatus, are usually mounted inside a metal cabinet resulting in extremely high temperatures that mitigate against good efficiencies and long life for ordinary rectifiers. This new selenium rectifier will operate with only a slight drop in current output at a

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- Plating
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- Rinsing
- Cleaning
- Acid Solutions
- Alkaline Solutions
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- Steel Tanks
- Ceramic Tanks
- Unlined Tanks
- Tanks Lined with Asphalt
- Tanks Lined with Lead
- Tanks Lined with Rubber
- Tanks Equipped for Heating
- Tanks of practically any style for Metal Finishing

MUNNING & MUNNING, Inc.

Designers and Mfrs. of PLATING EQUIPMENT & SUPPLIES

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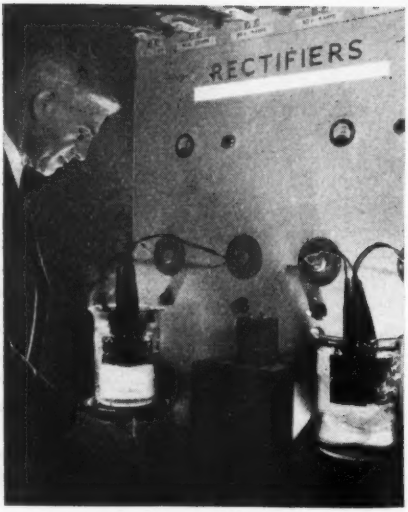
New York Philadelphia Woonsocket, R. I.



Selenium Rectifier Impervious to Heat, Cold. Dampness—Steam can be seen rising from the water boiling in the beaker at the left. In the other, pieces of ice can be seen floating. Yet the two hermetically sealed selenium rectifiers immersed in these beakers are turning alternating current into direct current at an efficiency equal to that under normal conditions.

total temperature higher than the boiling point of water and will last much in excess of 1,000 hours.

Extremes in temperature are not the only enemies of the rectifier. By actual test salt spray does not interfere with the performance of the new selenium rectifier but it will destroy an unprotected rectifier on the deck of a ship in a few hours. In tropical areas, insects, fungi and humidity quickly ruin the ordinary open-type rectifier but the hermetically sealed selenium unit is impervious to their attack.

New Decarbonizing Cleaner

Magnus 755 metal parts cleaner, made by Magnus Chemical Co., Inc., Garwood, N. J., is now available to civilian users. Developed to meet the Army Air Force's need for a fast, effective compound to clean combat aircraft engine parts during reconditioning, the new product quickly proved outstanding in removing the most tenacious gums, sludge and engine varnish while reducing parts cleaning time from four hours to one hour, thereby saving three hours per engine.

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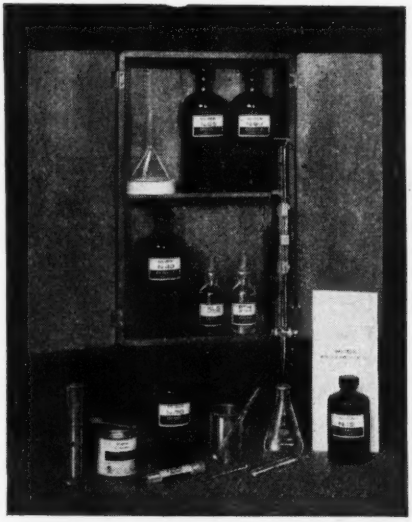

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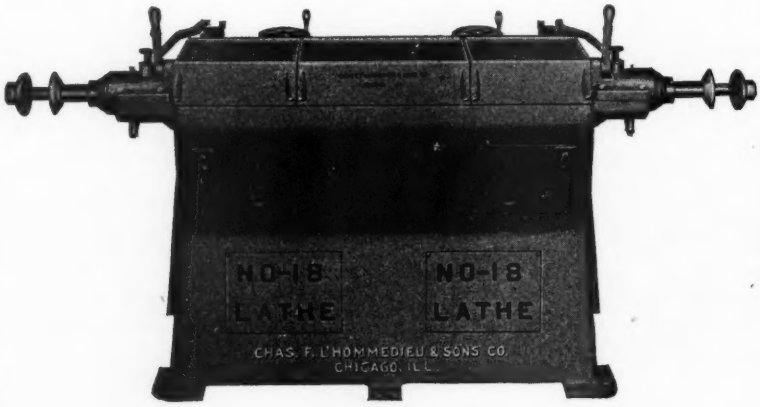

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(Continued on next page)

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(*Continued from preceding page*)

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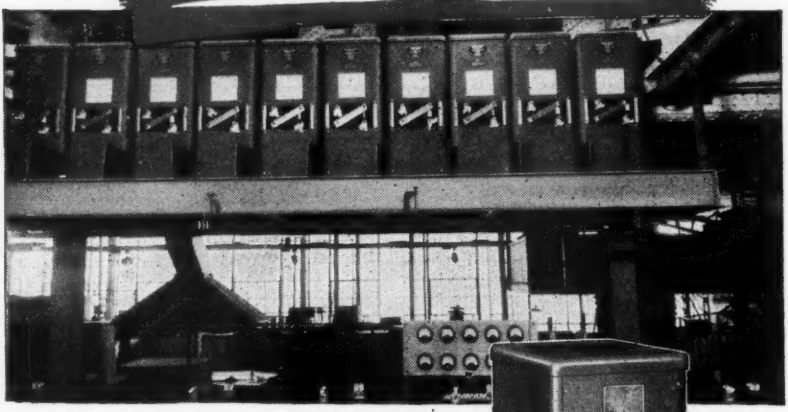

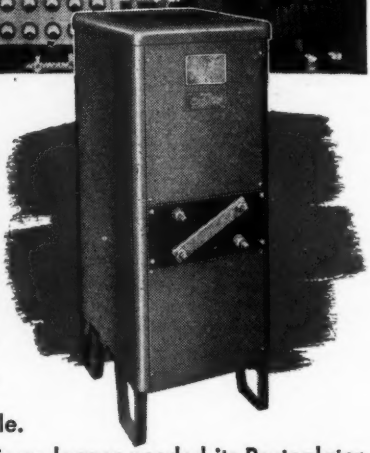

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TECHNICAL

DATA SHEET

No. 2

DYCLENE E

REVERSE CURRENT CLEANER FOR DIE CASTINGS

OPERATING CONDITIONS

Dyclene "E" is a highly buffered white alkaline salt for use in the reverse current cleaning of Zinc Die-cast Metals. When used under the following conditions, it will aid in producing bright adherent deposits capable of being baked at high temperatures without blisters or peeling.

Concentration	4-8 oz. gal.
Temperature	180° F. to 200° F.
Cleaning Time	15 seconds to one minute
Polarity	Reverse current, i.e. work as anode
Current Density	15-25 amps. sq. ft. at 6 volts

TYPICAL CYCLE

Assuming that the buffed discoating is reasonably clean with no chunks of grease tripoli on it when the work reaches the plating room, the following cycle produces excellent results:

1. Reverse current clean, 6 oz. gal. Dyclene "E" for 30 seconds.
2. Cold water rinse.
3. 1 3/4 % Sulfuric acid dip, 10 sec. When longer acid dips are required, the use of 1%-3% solutions of acetic, hydrofluoric or phosphoric acids may be used.
4. Cold water rinse.
5. Copper plate.

PRECLEANING

The work to be cleaned in the above cycle should be precleaned unless it is buffed with a lime compound or very dry tripoli. The following methods are in the order of their efficiency. See bulletin on Pressure Spray Cleaning.

1. Spray pressure clean. Meters 3011 4S, 1/4 to 1 oz. gal. Premex 4lbs. 150-160° F., three minutes
2. Spray and immersion in degreaser using filtered trichlorethylene
3. Soak in Premex emulsion 3% lbs. volume plus 5 oz. gal. Premex 4lbs. 150-160° F., 30 sec. to 1 minute or more. See bulletin on Premex.
4. Direct current clean in Metalex, 4.6 oz. gal. 180-200° F., 30 sec. to 1 minute.

The most efficient method of removal of heavily impacted dried buffing compound is to use a combination of Steps 3 and 4 above followed by the normal cycle of reverse current clean in Dyclene "E" as outlined under Typical Cycle.

OTHER APPLICATIONS

Dyclene "E" has an additional advantage in its formulation which allows one to use this material for cleaning buffed copper and steel if the degree of contamination is not too great. The same conditions and concentrations as cleaning for direct metals are applicable to steel and copper. If the predominance of work is steel and copper, however, our Anodex #1 A bulletins on this available should be used.

* If unbuffed castings are being cleaned, however, prior to chromate coatings such as Iridite or Cronak, a 30-second to one-minute immersion in Anodex at 6.12 oz. gal. at 200° F. will thoroughly activate the surface so that a uniform chromate coating will result. If the immersion should darken the castings, a dip in 1% nitric acid will restore its color.

The use of removable steel nickel plated electrodes is strongly recommended for all electrocleaning operations.

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December, 1945

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